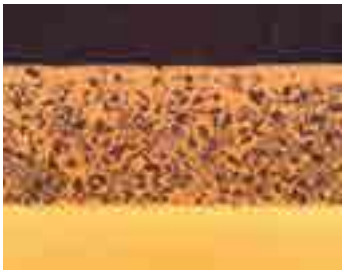
DURUM
VERSCHLEISS-SCHUTZ GMBH

www.durmat.com

Products and Services for Oilfield Equipment



DIN EN ISO 9001:2008
Cert. No.: 01 100 040463

WEAR SOLUTIONS

With Creative Ideas for Practical Solutions

DURUM VERSCHLEISS-SCHUTZ GMBH was established in 1984 as a manufacturer of advanced hard-facing products. Today DURUM has production and service centres in Brazil, France and the USA and exports to more than 80 countries all over the world!

DURUM provides high performance products for Welding and Thermal Spraying. DURUM is a global market leader in the supply of specialized overlaying consumables that can be applied by a range of processes including: Flux-Cored Wire Welding, Plasma Transferred Arc (PTA) Welding, Oxyacetylene Welding, Thermal Spraying.

Besides Willich (Germany) DURUM Group maintains production and workshop facilities in Brazil (São Paulo), France (Saint Victor) and the USA (Houston TX). We also support a network of independent agencies throughout the world. We meet demanding requirements of today's industry with a wide array of Welding and Thermal Spray technologies.

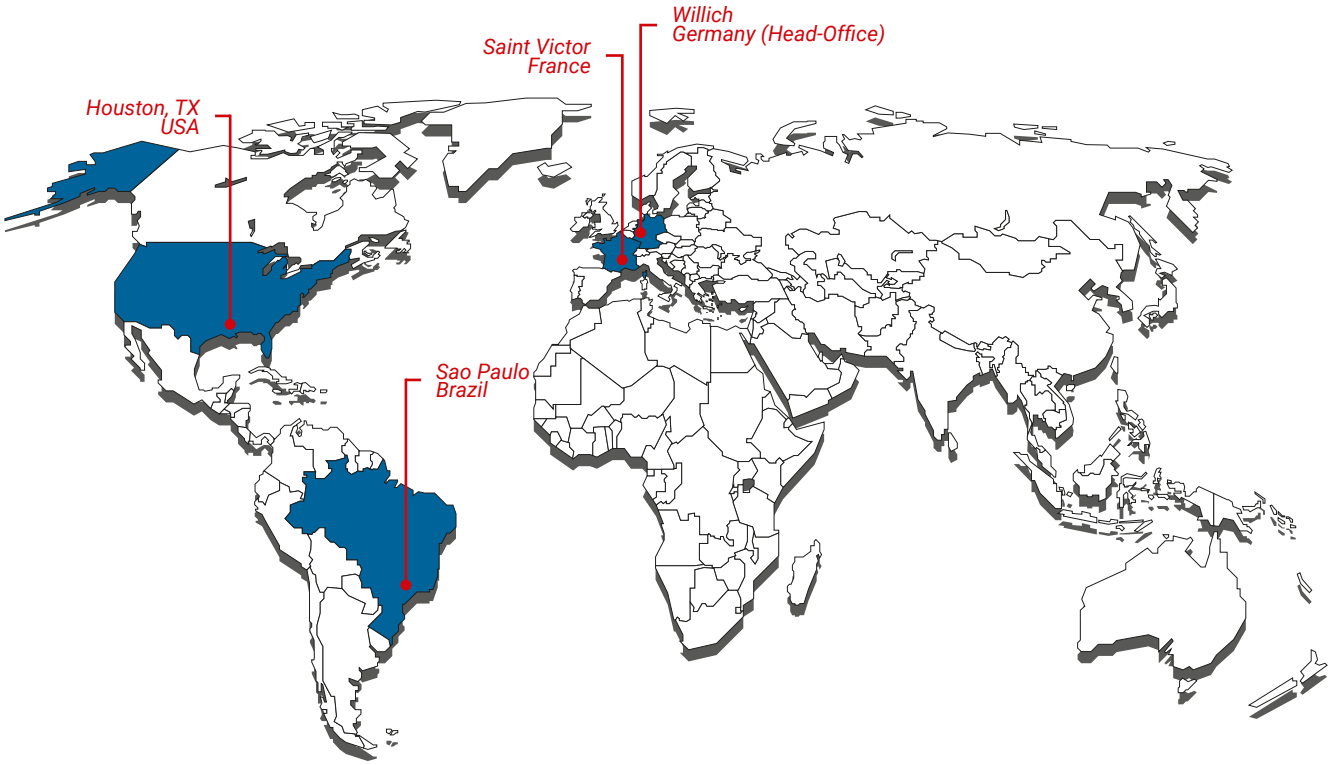
The company employs national and international PhD's; welding engineers and independent experts from well known and respected universities, which ensures that constant material and process development is achieved to the highest standards.

DURUM focuses on "continuous development" and sets a significant annual budget aside for research and development including new product development, product enhancement and the development of highly specialised solutions to the most challenging applications in the industry.

Our wide range of specialized surface hard-facing materials includes:

- Tungsten Carbide Rods for Oxy-acetylene Welding
- Nickel-, Cobalt- and Iron-based Flux-Cored Wire
- FCAW wires with Tungsten Carbide and complex carbides to provide extremely hard and tough coatings, used principially for extreme wear applications
- Tungsten Carbides, Complex Carbides and Chromium Carbides for manual Arc Welding
- PTA Welding Powders
- PTA machines, torches and powder feeders
- Powders for Oxy-acetylene Welding and Spraying
- Fused Crushed and Spherical Fused Tungsten Carbides
- Pre-manufactured replacement wear parts
- Thermal Spray Powders (conforming to DIN EN 1274)
- Thermal Spray Wires (conforming to DIN EN 14919)

Rev. 2.0 (04.2018)



The Right Product for the Right Application

The advent of horizontal drilling and other advancements has created new challenges that leave the majority of traditional hard-banding products obsolete.

DURUM's commitment with investing in new technological advances, as they relate to material science and process application has resulted in several recent developments that have demonstrated superior performance in terms of reducing casing wear, increasing wear resistance and improving consistency in harsh/aggressive drilling environments.

A few of the primary factors include:

- The addition of elements such as Niobium, Molybdenum, Titanium, Cobalt, Titanium or Vanadium are beneficial by forming the respective carbides that reduce the coefficient of friction.
- The formation of microstructures that exhibit amazing stability during high temperature conditions resulting from friction
- The use of alloying elements that improve the thermal conductivity to minimize typical coating failures (i.e., heat checking)

PRO FUSION STABILIZER 3.0

Easy to operate Stabilizer welding machine.

Stabilizer Hard-facing with DURMAT® NIFD Tungsten Carbide Wires.

Automatic 4 axes X, Y, Z, plus spindle A.

Oscillation is available on the Y - axis.

PRO FUSION 3.0 is suitable to overlay a 36 " stabilizer within 2 hours by using DURMAT® NIFD Flux-Cored Wire diameter 2.8 mm, operating one blade at a time.

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Stabilizer Welding Equipment made by DURUM France

Item	Unit	Spec
Mini Size Stabilizer	inch	5 7/7"
Max Size Stabilizer	inch	36"
Max weight	Kg	4000
Spindle center height	mm	800
Workpiece diameter max	mm	450
Spindle revolution speed	r/min	0 to 4
Max. trav of X-axis	mm	1600
Max. trav of Y-axis	mm	600
Max. trav of Z-axis	mm	600
Max. rot of A-axis	deg	360
Overall dimension (L x W x H)	mm	5000 x 2000 x 2500

Item	Unit	Spec
Flux-Cored Wire max diameter	mm	2.8
Power Source Amperage	Amp	850 A at 40%
	Amp	650 A at 100%
Power Source Voltage	Volt	52 V at 40%
	Volt	44 V at 100%
Heavy Duty Welding Torch	-	-

The PRO FUSION STABILIZER 3.0 is equipped with FANUC system. An interface made by DURUM is integrated into the CNC.

Ref FANUC	Designation
A02B-0338-H112	CNC 0I-MF LCD Touch panel Interface
A06B-0826-J001	PMC automat system
A03B-0823-C011	DCS (Automat security system)
A06B-6250-H011	Power supply Module
A06B-6290-H303	Axe X/Y/A
A06B-6290-H102	Axe Z
A06B-2076-B203	Universal Brushless Motor

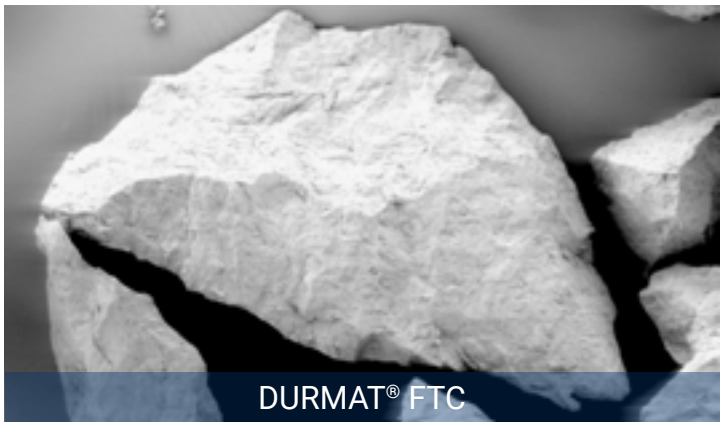
DURMAT® FTC

Fused Tungsten Carbide (FTC) is an extremely hard, wear resistant material. Its abrasion resistance is superior in terms of wear resistance to all other commercially available materials except diamond. It is far superior to any of the chromium carbide products presently in use and will always deliver very positive test results by comparison. This material forms the basis of all DURUM's abrasion-resisting products.

The properties of the FTC are very much dependent on its structure. FTC which demonstrates at least an 80 % "feather" structure has a macro-hardness of approximately 2,000 HV_{30}. The micro-hardness of this material has been measured at 2,300 - 2,500 $HV_{0.1}$.

FTC has a carbon content of 3.8 - 4.1 %. This corresponds to a ratio of 78 - 80 % W_2C and 20 - 22 % WC. Careful attention must be paid during the processing and application of products containing FTC, that the temperature does not exceed 1,800 °C. Higher temperatures would cause an alteration in the structure resulting in a loss of hardness. If this excessive overheating occurs during the welding procedure, an unproportionately high amount of FTC will be dissolved in the iron matrix, which would also result in a reduction of the material's superior ability to resist wear.

Product	-	DURMAT® FTC	DURMAT® SFTC
Alloy type	-	WC - W_2C	WC - W_2C
Parameter	Unit	Typical data	
C-TOTAL	%	3.8 - 4.1	3.8 - 4.1
C-FREE	%	0.1 max.	0.1 max.
O_2 SIEVE RANGE	%	0.05 max.	0.05 max.
O_2 SUB SIEVE RANGE	%	0.2 max.	0.2 max.
Fe	%	0.3 max.	0.3 max.
Co	%	0.3 max.	0.3 max.
Hardness	$HV_{0,1}$	2,360	3,000
Structure	-	mainly feather	fine
Density	g/cm^3	16 - 17	16 - 17
Melting point	°C/°F	2,860/5,176	2,860/5,176

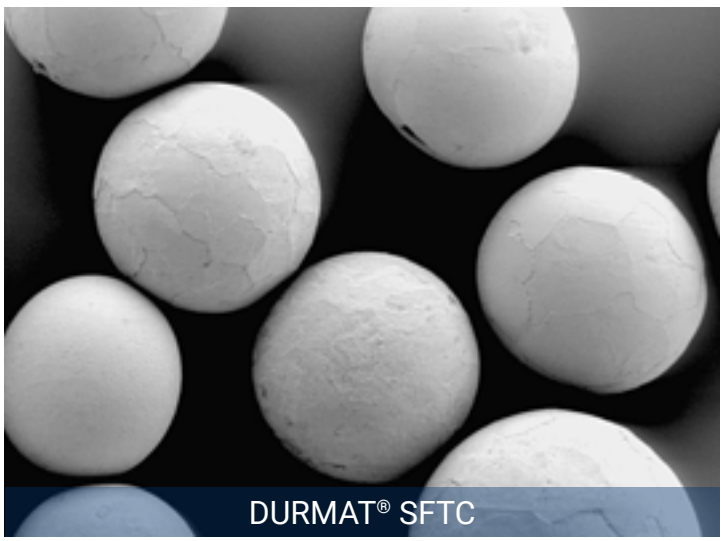

DURMAT® FTC

DURMAT® SFTC

DURMAT® Spherical Fused Tungsten Carbide (SFTC) is the most wear resistant Fused Tungsten Carbide we can offer.

These spherical fused tungsten carbide particles show a fine non-acicular structure with a higher hardness than conventional FTC (> 3,000 $HV_{0.1}$). The increased apparent density combined with a better flowability enables an increase of hard particles in wear resistant coatings and components produced by infiltration.

Using powder metallurgical processes, it is possible to produce parts of nearly any shape, which can contain hard materials or diamonds together with a metal binder and SFTC, reinforcing the hardness of diamond tools. Excellent for deep well drilling tools and rods, crusher jaws, mixers, concrete & stone saws, hot-pressed tools, screens & conveyors, extrusion housings and hard additives to diamond bits and saws.


DURMAT® SFTC

Rev. 2.0 (04.2018)

DURMAT® RF 13

According to their outstanding mechanical properties, hard-facing alloys based on Tungsten Carbide and cobalt take a central position in wear protection. The high demands, which are placed on the wear resistance of such alloys these days, have led to increasingly finer micro structures with optimized compositions, allowing improved, higher performance alloys to be achieved.

Their characteristic, fine-structured composition with crystallite grain sizes of max. 400 nm is their trademark and a guarantee for high wear resistance. Compared to common Tungsten Carbide-Cobalt alloys we have achieved better wear resistance, by using smaller WC structure. Our DURMAT® RF 13 development using fine-structured WC has resulted in hardness of approximately 1,750 $HV_{0.5}$.

The higher hardness of the nano-scale hard-facing alloy associated with the decreasing WC grain size reduces wear from abrasion considerably. The harder "hard metal" counters abrasion with a greater resistance. Wear progresses significantly slower, as the binding metal layer between the fine grain hard-facing crystallites is exceptionally thin, making it harder to wash out. Due to this structural attribute, only very small hard-facing particles are torn out.

The spherical shape represents a further form of protection, which is further stabilized by the small grain size; a lot more energy has to be applied for fragmentation of small particles compared to large particles due to the presence of less defects.

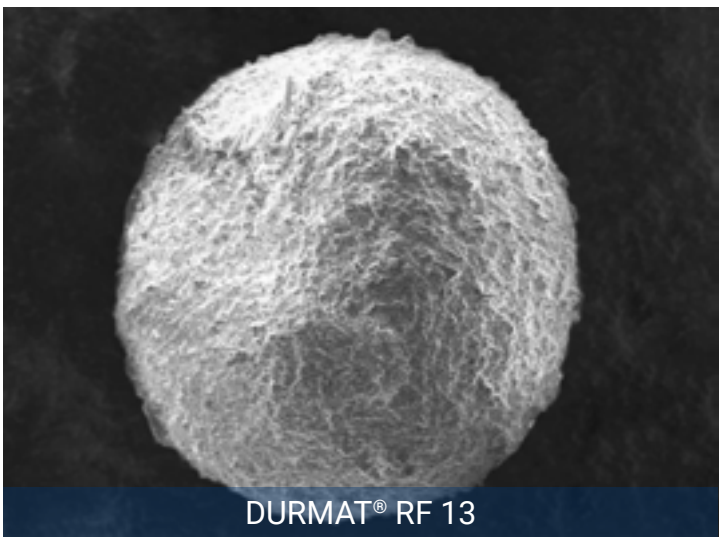
A characteristic, higher wear resistance also occurs with regard to corrosive wear. As a result of the nano-structure and in particular the significantly reduced intermediate binding metal layer, the corrosive media can only reach the cobalt with difficulty, leading to considerable delays in wear. In turn, only the smallest hard-facing particles escape, corrosion is slowed down considerably.

DURMAT® MCWC

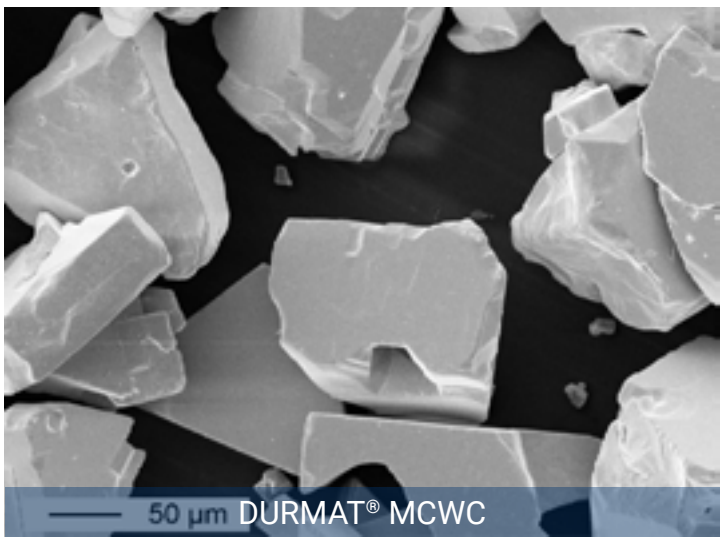
The Macro-Crystalline Tungsten Carbide (DURMAT® MCWC) is a fully carburized stoichiometric compound with a carbon content of 6.14 % by weight.

Based on its stable single-phase micro-structure, nearly no dissolution of the Macro-Crystalline Tungsten Carbides is observed after the welding process. MCWC has good weldability with nickel-based alloys during the PTA application process. The thermodynamically more stable MCWC has a blocky shape with low decarburization during processing.

The carbide hardness amounts 1,700 - 2,000 $HV_{0.1}$. The DURMAT® MCWC can stay in service up to 500 °C (930 °F).



DURMAT® RF 13



DURMAT® MCWC

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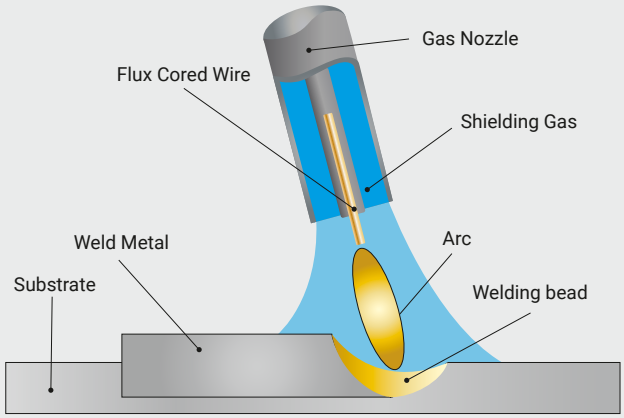
Gas Metal Arc Welding (GMAW) / Flux-Cored Arc Welding (FCAW) or MIG/MAG:



Gas Metal Arc Welding (GMAW), sometimes referred to by its subtypes Metal Inert Gas (MIG) welding or Metal Active Gas (MAG) welding, is a welding process in which an electric arc forms between a consumable wire electrode and the workpiece metal(s), which heats the workpiece metal(s), causing them to melt and join. By using Flux-Cored Wires the process is called Flux-Cored Arc Welding (FCAW). An externally supplied shielding gas is sometimes used, but often the flux itself is relied upon to generate the necessary protection from the atmosphere, producing both gaseous protection and liquid slag protecting the weld.

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DURMAT® NIFD

Flux-Cored Wire DIN EN 14700: T Ni20
(DIN 8555: MF21-55-CGZ)

Industry standard for highest wear protection

General characteristics:

DURMAT® NIFD is a Flux Cored Wire (NiCrBSi) filled with Fused Tungsten Carbide (FTC) for semi-automatic welding application. DURMAT® NIFD protects surfaces where extreme abrasive wear in combination with corrosion is encountered. The deposit alloy consists of approximately 50 - 65 % FTC and 35 - 50 % Ni-Cr-B-Si-matrix. The alloy has a low melting range of between 900 - 1,050 °C (1,652 – 1,922 °F) and flows extremely well and leaves a smooth and clean surface. The matrix is highly resistant to acids, bases, lye and other corrosive media.

Application:

Repairing and hard-facing ferritic and austenitic steel tools and machine parts (steel castings) in the chemical industry and food industry; stabilizers in the petroleum industry, mixer blades, conveyors and screws in the chemical, dye industry and in the food processing industry; mineral and brick industry.

Typical Hardness:

FTC: ≈ 2,360 $HV_{0.1}$
Matrix: 450 - 480 $HV_{0.1}$

Sales units:

Ø mm	Ø inch	Coil size DIN EN 759	Amps	Voltage
1.2	0.045	BS-300 spools ≈15 kg	100 - 160 A	16 - 20 V
1.6	1/16	BS-300 spools ≈ 15 kg	110 - 180 A	18 - 20 V
2.0	5/64	BS-300 spools ≈ 15 kg	120 - 200 A	17 - 21 V
2.4	3/32	B-450 spools ≈ 25 kg	140 - 230 A	21 - 23 V
2.8	7/64	B-450 spools ≈ 25 kg	160 - 260 A	21 - 23 V
3.2	1/8	B-450 spools ≈ 25 kg	200 - 280 A	23 - 25 V

vacuum packaging is available on request

Patents:
Germany: No. 40 08 091.9-41, United Kingdom: No. 2.232.108, USA: No. 5.004.886

DURMAT® NIFD PLUS

Flux-Cored Wire DIN EN 14700: T Ni20
(DIN 8555: MF21-55-CGZ)

Improved Material with SFTC.

General characteristics:
DURMAT® NIFD PLUS is a Flux Cored Wire (NiCrBSi) filled with Spherical Fused Tungsten Carbide (SFTC) for semi-automatic welding application. These SFTC show a fine acicular structure with a higher hardness than FTC. DURMAT® NIFD PLUS was developed to protect surfaces where extreme abrasive wear in combination with corrosion are encountered.

Application:
While having similar properties as DURMAT® NIFD, DURMAT® NIFD PLUS can be applied in many NIFD applications when even superior wear protection through spherical SFTC is needed.

Typical Hardness:
SFTC: > 3,000 $HV_{0.1}$
Matrix: 450 - 480 $HV_{0.1}$

DURMAT® NI 2

Flux-Cored Wire DIN EN 14700: T Ni20
(DIN 8555: MF21-55-CGZ)

Improved Material for application with very fine abrasives.

General characteristics:
DURMAT® NI 2 is a cored metal wire filled with a combination of very hard special carbides together with Fused Tungsten Carbides (FTC) and Ni-Cr-B-Si-for semi-automatic welding application. DURMAT® NI 2 was developed to protect surfaces against extreme abrasive wear in combination with corrosion attacks. The alloy has a low melting range of between 900 - 1,050 °C (1,652 - 1,922 °F) and features a self fluxing characteristic producing a smooth and clean surface. The matrix is highly resistant to acids, bases, lye and other corrosive media.

Application:
While having similar properties as DURMAT® NIFD, DURMAT® NI 2 can be applied in many NIFD applications when extra matrix protection is needed. This is the case with parts prone to aggressive erosion attack with direct particle impact.

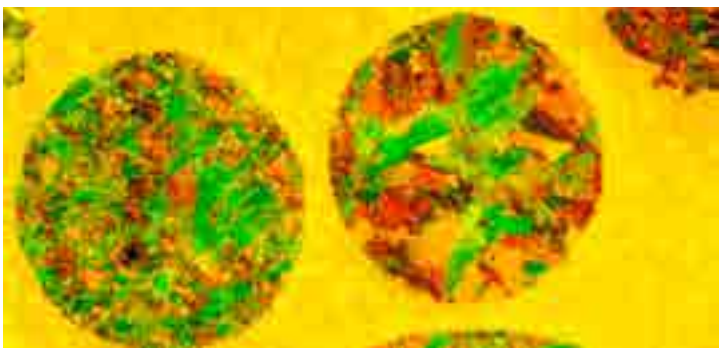
Typical Hardness:
FTC: ≈ 2,360 $HV_{0.1}$
Other carbides: ≈ 2,900 $HV_{0.1}$
Matrix: 450 - 480 $HV_{0.1}$

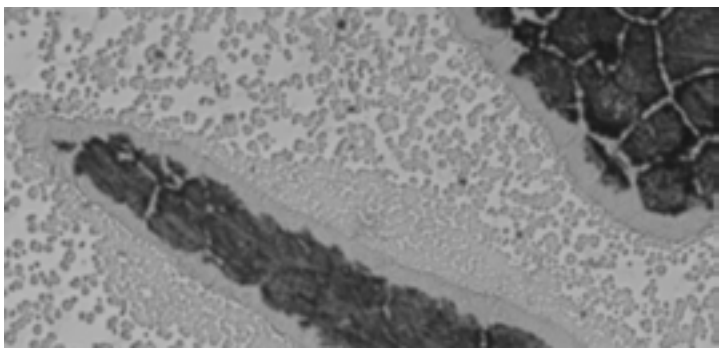
Sales units:

DURMAT®	Ø mm	Ø inch	Coil size DIN EN 759	Amps	Voltage
NI-2	1.6	1/16	BS-300 spools ≈ 15 kg	110 - 180 A	18 - 20 V
NIFD PLUS / NI-2	2.4	3/32	B-450 spools ≈ 25 kg	140 - 230 A	21 - 23 V
NIFD PLUS / NI-2	2.8	7/64	B-450 spools ≈ 25 kg	160 - 260 A	21 - 23 V
NIFD PLUS / NI-2	3.2	1/8	B-450 spools ≈ 25 kg	200 - 280 A	23 - 25 V

vacuum packaging is available on request

Patents:
Germany: No. 40 08 091.9-41, United Kingdom: No. 2.232.108, USA: No. 5.004.886





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DURMAT® NICRW

Flux-Cored Wire DIN EN 14700: T Ni20
(DIN 8555: MF21-55-CGZ)

NiCr + DURMAT® FTC

General characteristics:

DURMAT® NICRW is a flux-cored wire with approx. 50 % FTC and 40 % NiCrBSi-matrix, similar DURMAT NIFD, but containing higher Chrome content. Good corrosion protection against chloride media. DURMAT® NICRW was developed to protect surfaces against extreme abrasive wear in combination with corrosion attacks. The alloy has a low melting range of between 900 - 1,050 °C (1,652 - 1,922 °F) and feature self fluxing characteristic producing a smooth and clean surface. The matrix is highly resistant to acids, bases, lye's and other corrosive media.

Application:

While having similar properties as DURMAT® NIFD, NICRW can be applied in many NIFD applications when even superior wear protection to acids, bases, lye's and other corrosive media is needed.

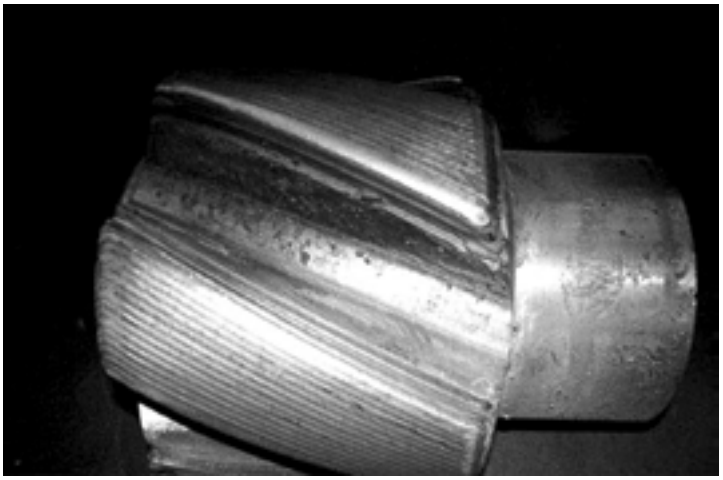
Typical Hardness:

FTC: ≈ 2,360 $HV_{0.1}$
Matrix: 490 - 540 $HV_{0.1}$

Sales units:

Ø mm	Ø inch	Coil size DIN EN 759	Amps	Voltage
1.6	3/32	BS-300 spools ≈ 15 kg	160 - 180 A	18 - 20 V
2.4	7/64	B-450 spools ≈ 25 kg	200 - 230 A	21 - 23 V
2.8	1/8	B-450 spools ≈ 25 kg	220 - 260 A	21 - 23 V

vacuum packaging is available on request



DURMAT® FD 773

Flux-Cored Wire DIN EN 14700: T Ni20
(DIN 8555: MF21-55-CGZ)

NiCr + DURMAT® RF 13

General characteristics:

DURMAT® FD 773 is a flux-cored wire with approx. 50 % DURMAT® RF 13 and 40 % NiCrBSi-matrix. Good corrosion protection against chloride media. DURMAT® FD 773 was developed to protect surfaces against extreme abrasive wear in combination with corrosion attacks.

Typical Hardness:

RF 13: > 1,950 $HV_{0.1}$
Matrix: 490 - 540 $HV_{0.1}$

SALES UNITS:

Ø mm	Ø inch	Coil size DIN EN 759	Amps	Voltage
1.6	3/32	BS-300 spools ≈ 15 kg	160 - 180 A	18 - 20 V
2.0	7/64	B-450 spools ≈ 25 kg	190 - 200 A	19 - 21 V

vacuum packaging is available on request

DURMAT® FD 774

Flux-Cored Wire DIN EN 14700: T Ni20
(DIN 8555: MF21-55-CGZ)

Co + DURMAT® RF 13

General characteristics:

DURMAT® FD 774 is a flux-cored wire with approx. 50 % DURMAT® RF 13 and 40 % Co-matrix. Good corrosion protection against chloride media. DURMAT® FD 774 was developed to protect surfaces against extreme abrasive wear in combination with corrosion attacks.

Typical Hardness:

RF 13: > 1,950 $HV_{0.1}$
Matrix: 450 - 480 $HV_{0.1}$

Sales units:

Ø mm	Ø inch	Coil size DIN EN 759	Amps	Voltage
1.6	3/32	BS-300 spools ≈ 15 kg	160 - 180 A	18 - 20 V
2.0	7/64	B-450 spools ≈ 25 kg	190 - 200 A	19 - 21 V

vacuum packaging is available on request

DURMAT® FD 778

Flux-Cored Wire DIN EN 14700: T Ni20
(DIN 8555: MF21-55-CGZ)

NiFe + DURMAT® FTC

General characteristics:

DURMAT® FD 778 is a Flux-Cored Wire with approx. 50 - 65 % FTC. DURMAT® FD 778 was developed to protect surfaces against extreme abrasive wear in combination with corrosion attacks. The deposit alloy consists of approx. 50 - 65 % FTC and an austenitic NiFe-matrix. The alloy has a much lower melting point than commonly used iron based Flux Cored Wires with tungsten carbide filling and feature self fluxing characteristic producing a smooth and clean surface. The matrix shows a good resistance to corrosive media.

Typical Hardness:

FTC: ≈ 2,360 $HV_{0.1}$
Matrix: 490 - 540 $HV_{0.1}$

DURMAT® FD 780

Flux-Cored Wire DIN EN 14700: T Ni20
(DIN 8555: MF21-55-CGZ)

NiFe + DURMAT® MCWC

General characteristics:

DURMAT® FD 780 was developed to protect surfaces against extreme abrasive wear in combination with corrosion attacks. The deposit alloy consists of approx. 50 - 65 % MCWC and an austenitic NiFe-matrix. The alloy has a much lower melting point than commonly used iron based Flux-Cored Wires with MC tungsten carbide filling and feature self fluxing characteristic producing a smooth and clean surface. The matrix shows a good resistance to corrosive media.

Typical Hardness:

MCWC: > 1,700 $HV_{0.1}$
Matrix: 490 - 540 $HV_{0.1}$

DURMAT® FD 779

Flux-Cored Wire DIN EN 14700: T Ni20
(DIN 8555: MF21-55-CGZ)

Ni + DURMAT® MCWC

GENERAL CHARACTERISTICS:

DURMAT® FD 779 was developed to protect surfaces against extreme abrasive wear in combination with corrosion attacks. The deposit alloy consists of approx. 50 - 65 % MCWC and an austenitic Ni-matrix. The alloy has a much lower melting point than commonly used iron based Flux Cored Wires with MC tungsten carbide filling and feature self fluxing characteristic producing a smooth and clean surface. The matrix shows a good resistance to corrosive media.

Typical Hardness:

MCWC: > 1,700 $HV_{0.1}$
Matrix: 490 - 540 $HV_{0.1}$

Sales units:

Ø mm	Ø inch	Coil size DIN EN 759	Amps	Voltage
1.6	3/32	BS-300 spools ≈ 15 kg	160 - 180 A	18 - 20 V
2.4	7/64	B-450 spools ≈ 25 kg	200 - 230 A	21 - 23 V
2.8	1/8	B-450 spools ≈ 25 kg	220 - 260 A	21 - 23 V

vacuum packaging is available on request

DURMAT® FD 789

Flux-Cored Wire DIN EN 14700: T Ni20
(DIN 8555: MF21-55-CGZ)

Ni + DURMAT® RF 13

General characteristics:

Good corrosion protection against chloride media. DURMAT® FD 789 was developed to protect surfaces against extreme abrasive wear in combination with corrosion attacks. The deposit alloy consists of approx. 50 % DURMAT® RF 13 and 40 % NiBSi-matrix.

Typical Hardness:

RF 13: > 1,950 $HV_{0.1}$
Matrix: 450 - 480 $HV_{0.1}$

Sales units:

Ø mm	Ø inch	Coil size DIN EN 759	Amps	Voltage
1.6	3/32	BS-300 spools ≈ 15 kg	160 - 180 A	18 - 20 V
2.4	7/64	B-450 spools ≈ 25 kg	200 - 230 A	21 - 23 V
2.8	1/8	B-450 spools ≈ 25 kg	220 - 260 A	21 - 23 V

vacuum packaging is available on request

Rev. 2.0 (04.2018)

GMAW vs. Oxy-acetylene

Following is an example of the procedures that are used by DURUM VERSCHLEISS-SCHUTZ GMBH for overlay and repair of oil tools. DURMAT® NIFD is used for oil tools in western Canada, Colombia, Venezuela, North Sea, Australia, Thailand, USA (Texas, Louisiana, Wyoming, Oklahoma and Mississippi).

An oxyacetylene process to overlay a composite material of Tungsten Carbide enclosed in a nickel matrix is generally used to repair the stabilizer and centralizer sleeves used in directional drilling. DURMAT® NIFD wire offers an alternative process for new and repaired tools. Not only does it solve most of the technical problems linked with the conventional method, but is also a cost-effective solution.

Conventional method: Oxyacetylene

The best materials used for repair are most often made of Fused Tungsten Carbide in a Nickel Chromium matrix. The concentration of tungsten carbides for an optimum abrasion resistance is between 55 and 65 % by weight. DURMAT® B / BK or DURMAT® NIA is successfully used in the oil field on regular type stabilizers in very abrasive formations. Several problems can occur when the oxyacetylene process is used to repair the sleeve type stabilizers.

The oxyacetylene application requires a preheating of the entire part at 600 °F. Then the overlay process itself adds heat input. This high heat input on a thin sleeve can warp the part, which then affects the threaded connection and renders the sleeve useless.

The problem is aggravated by the low rate of deposit of those types of materials. A welder in a good working environment can apply 3 - 5 lbs. of material per hour.

The manual application leaves a wavy type deposit that needs to be OD grinded. Sometimes after grinding, the blades show a lack of material which needs to be replaced.

Alternative: MIG process using DURMAT® NIFD wire

The DURMAT® NIFD wire is made of a Nickel strip formed and closed into a hollow wire. That envelope is filled with Fused Tungsten Carbide (FTC) grains before being closed. The result is a Flux-Cored Wire for MIG application. Since it can be welded on itself crack-free, this product can be used for overlays or repairs. The deposit shows a homogeneous dispersion of Fused Tungsten Carbide metallurgically bonded to the Nickel matrix. The major advantages of DURMAT® NIFD and the MIG process are:

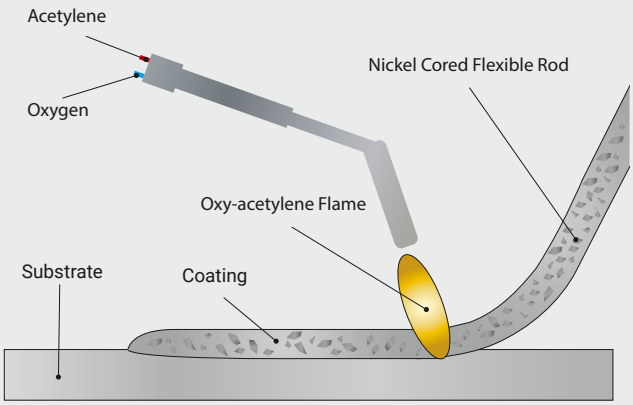
- The overlay can be done with just enough preheating to take the chill and humidity out of the metal base.
- The DURMAT® NIFD Nickel strip melts at approximately 1,750 °F. This enables you to control the heat input in the stabilizer blades and avoid distortion of the part or the connection threads.
- Because of the low heat input, no post-heat treatment is necessary after welding.
- The rate of deposit by hand increases to 10 - 15 lbs. per hour, depending on the size of the part.
- The repair can be fully automated at a low cost, as the setup for a straight-blades stabilizer is very easy and can be done with common equipment. Deposition rate can increase up to 25 lbs. per hour.
- The overlay thickness is more uniform than with an oxyacetylene application and the deposit thickness can be controlled (especially with an automatic setup). A more accurate estimate of the thickness can be made and less time is spent on the grinder.

EXAMPLE:

New sleeve with 4 straight blades 16" x 2"; final deposit should be 1/16" per blade.

	OXYACETYLENE:	DURMAT® NIFD with MIG:
Density of material:	0.39 lbs./cu.in. (av. buildup per blade = 1/4")	0.39 lbs./cu.in. (av. buildup per blade = 1/8")
Quantity of material used:	12.5 lbs.	6.25 lbs.
Time for preparation, preheating and welding:	4.5 to 5.5 hours	1 to 1.5 hours
Estimated grinding time:	1 hour	1/2 hour

Oxyacetylene Welding



Oxyacetylene welding, also known as Oxy-fuel Welding (OFW), is a gas welding process in which coalescence is produced by a flame of oxygen and acetylene gases mixed together at the point of ignition. With this family of processes, the base metal and a filler rod are melted using a flame produced at the tip of a welding torch. Fuel gas and oxygen are combined in the proper proportions inside a mixing chamber in the torch. Molten metal from the plate edges and filler metal, if used, intermix in a common molten pool and join when cooling. Commonly-used fuel gases include acetylene, propylene, propane and natural gas.

The equipment used in oxyacetylene welding is low in cost, usually portable, and versatile enough to be used for a variety of related operations such as bending and straightening, preheating, post-heating, surfacing, brazing, and braze welding. Among commercially available fuel gases, acetylene most closely meets the requirements for all these applications. A minimal dilution with the base material makes OFW suitable for surfacing applications. Further an advantage is that the welder can exercise precise control over heat input and temperature, independent of the addition of filler metal.

Vacuum sealed. On plastic or wooden spools: 10 / 15 / 20 kg.

Rev. 2.0 (04.2018)

DURMAT® B

Welding Rod DIN EN 14700: T Ni20-CGTZ
(DIN 8555: G21-UM-55-CG)

Industry standard for highest wear protection

General characteristics:
DURMAT® B is a nickel core flexible rod coated with both Fused Tungsten Carbide (FTC) and Ni-Cr-B-Si developed for oxyacetylene welding. The deposited alloy consists of approximately 65 % FTC and 35 % Ni-Cr-B-Si-matrix with a matrix hardness of 45 HRC. The overlay is highly resistant to acids, bases, lye and other corrosive media and excessive wear conditions. The rod has a low melting range of between 950 - 1,050 °C (1,742 - 1,922 °F) and features a self fluxing characteristic producing a smooth, clean welded surface.

Typical Hardness:
FTC: ≈ 2,360 $HV_{0.1}$
NiCrBSi-Matrix: ≈ 420 - 450 $HV_{0.1}$

Application:
Hard-facing of ferritic and austenitic steels (steel castings), applied for overlaying mixer blades, screws and conveyors in chemical and dye industries and the fool industry. Especially recommended for stabilizer blades in the petroleum industry.

Sales Units:

Type	Ø mm	Ø inch	Grain size in mm	US mesh size
4005	4.0	5/32	0.25 - 0.70	24 - 60
4010	4.0	5/32	0.70 - 1.20	14 - 24
5005	5.0	3/16	0.25 - 0.70	24 - 60
5010	5.0	3/16	0.70 - 1.20	14 - 24
5020	5.0	3/16	1.00 - 2.00	9 - 16
6005	6.0	1/4	0.25 - 0.70	24 - 60
6010	6.0	1/4	0.70 - 1.20	14 - 24
6020	6.0	1/4	1.00 - 2.00	9 - 16
8005	8.0	5/16	0.25 - 0.70	24 - 60
8010	8.0	5/16	0.70 - 1.20	14 - 24
8020	8.0	5/16	1.00 - 2.00	9 - 16

vacuum packaging is available on request

Rev. 2.0 (04.2018)

DURMAT® BK

Welding Rod DIN EN 14700: T Ni20-CGTZ
(DIN 8555: G21-UM-55-CG)

Improved Material with SFTC.

General characteristics:
DURMAT® BK is a nickel cored flexible rod coated with mainly Spherical Fused Tungsten Carbide (SFTC) and Ni-Cr-B-Si-matrix with a matrix hardness of 45 HRC. The hard-facing is highly resistant to acids, bases, lye, and other corrosive media and excessive wear conditions. The rod has a low melting range of between 950 - 1,050 °C (1,742 - 1,922 °F) and features a self fluxing characteristic producing a smooth, clean welded surface.

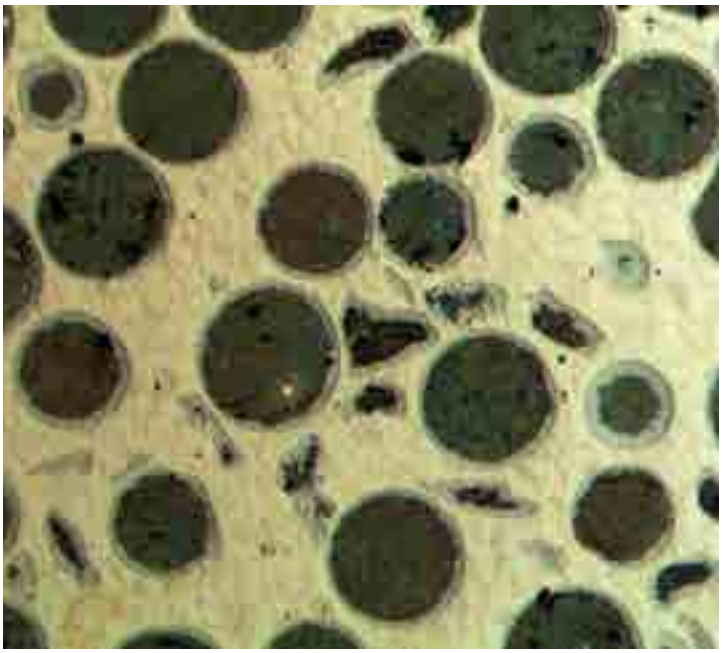
Typical Hardness:
SFTC: ≈ 3,000 $HV_{0.1}$
NiCrBSi-Matrix: ≈ 420 - 450 $HV_{0.1}$

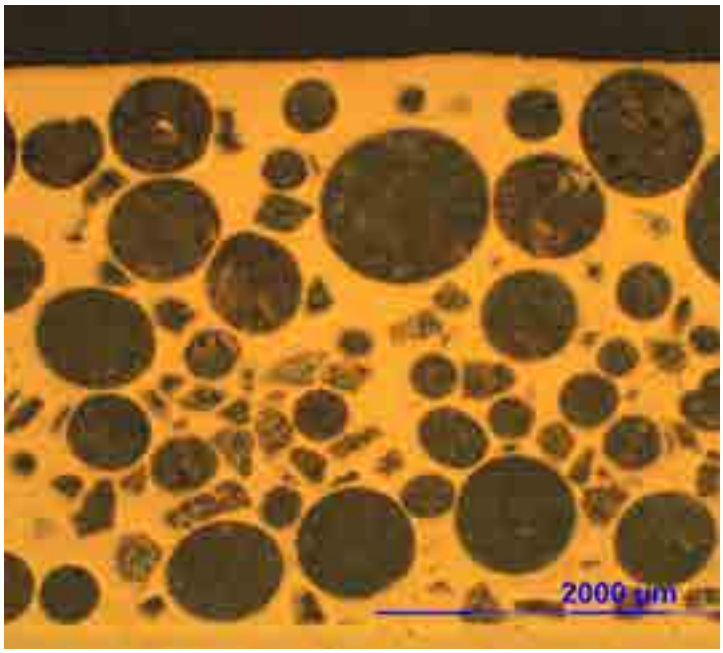
Application:
Hard-facing on ferritic and austenitic steels (steel castings), over-laying mixer blades, screws and conveyors in chemical and dye industries and the fool industry. Especially recommended for stabilizer blades in the petroleum industry.

Sales Units:

Type	Ø mm	Ø inch	grain size in mm	US mesh size
4005	4.0	5/32	0.25 - 0.70 / 0.25 - 0.84	24 - 60 / 20 - 60
5005	5.0	3/16	0.25 - 0.70 / 0.25 - 0.84	24 - 60 / 20 - 60
6005	6.0	1/4	0.25 - 0.70 / 0.25 - 0.84	24 - 60 / 20 - 60
8005	8.0	5/16	0.25 - 0.70 / 0.25 - 0.84	24 - 60 / 20 - 60

vacuum packaging is available on request



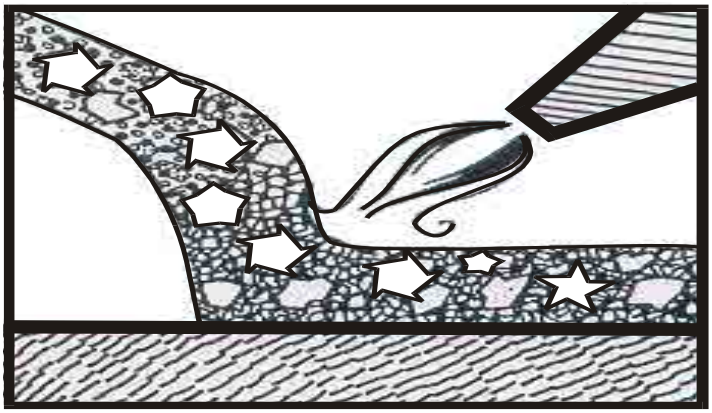


Rev. 2.0 (04.2018)

Oxyacetylene Welding Rods with Fused Tungsten Carbides

Application:

Hard-facing of ferritic and austenitic steels (steel castings), overlaying mixer blades, screws & conveyors in Chemical and dye industry, Food industry. Specially recommended for stabilizer blades in the petroleum industry.



Preparation and preheating:

Every surface to be hardfaced with DURMAT® B must be clean and free of oxydation, dirt or other surface contamination. In some instances a slight grinding operation might be necessary. All edges must be cut by grinding.

To increase the wettability and to avoid any oxidation during the hard-facing with DURMAT® B apply an buffer layer of Ni-Cr-B-Si powder of about 0.05 mm thickness on the surface.

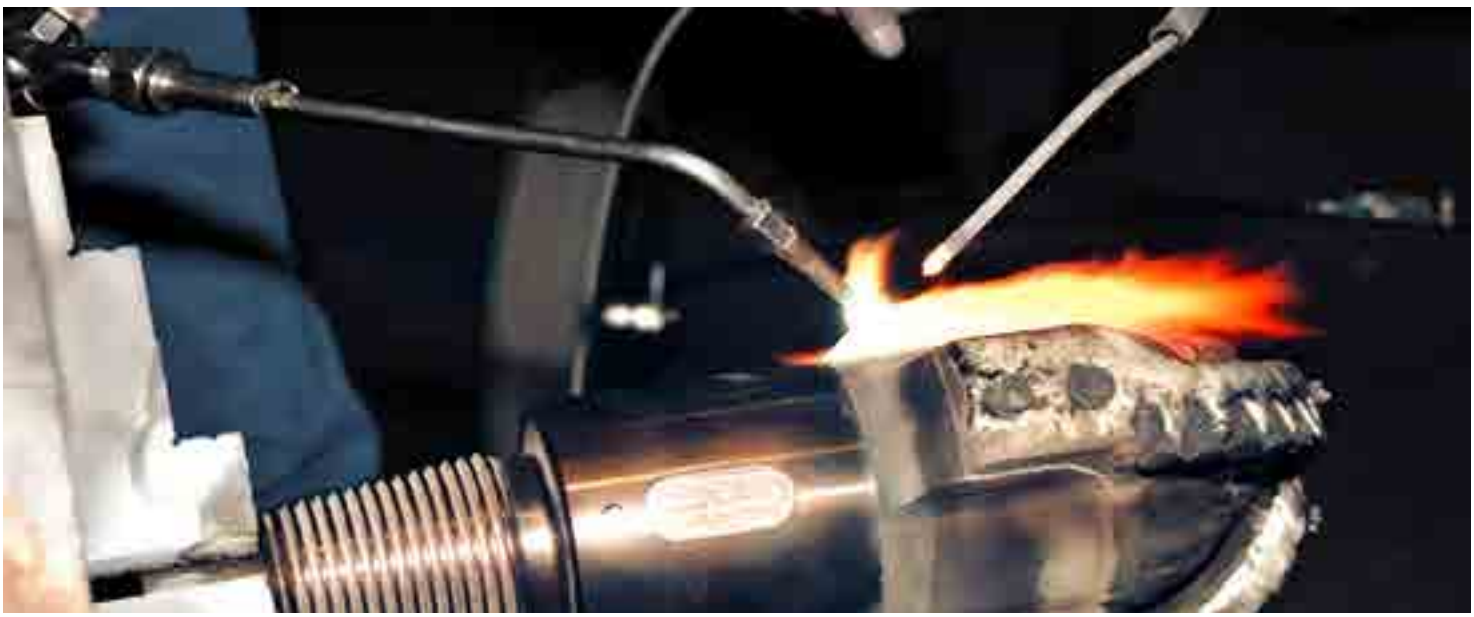
Preheat the part to about 300 - 350 °C.

Depositing:

Heat a small area to allow the buffer layer to melt, and then apply DURMAT® B, and when it flows, it will carry with it the tungsten carbide particles. The torch flame must form an angle of about 45°.

All edges applications must be done first, then an additional center pass may be added.

Remember: The flame must be directed on to DURMAT® B. The wire must be completely melted by the torch. The melting of the wire will transfer the proper bonding temperature to adhere permanently to the base material.



DURMAT® A

Welding Rod DIN EN 14700: T Fe20
(DIN 8555: G21-GF-55-CG)

General characteristics:

DURMAT® A consists of a special pre-alloyed tube filled with coarsely grained Fused Tungsten Carbide (FTC) for oxyacetylene welding. The FTC has an exceptionally high hardness of over 2,360 $HV_{0.1}$ giving outstanding wear protection to hard faced areas. For special hard facing on machine parts of unalloyed, low alloyed or cast steel with carbon content up to 0.45 %. Higher carbon content could lead to cracking. Depending on the size and composition of the area to be hard faced, the proper rod diameter and grain size should be chosen. If the area will encounter heavy abrasion a small grain size is recommended. If a cutting action is desired a larger grain size is preferable.

Typical Hardness:

SFTC: > 2,360 $HV_{0.1}$

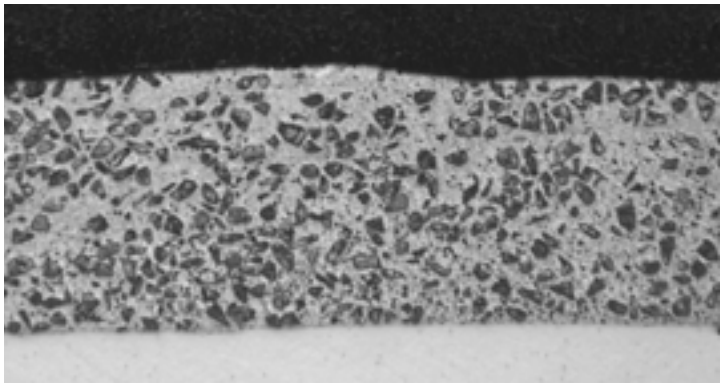
Application:

Hard-facing and repairing tools and machine parts exposed to wear in mining, road construction, ceramic, petroleum, excavation and dredging applications.

Sales units:

Type	Ø mm	Ø inch	Grain size mm	US Mesh size
3505	3.5	1/8	0.25 - 0.70	24 - 60
3510	3.5	1/8	0.70 - 1.20	14 - 24
4005	4.0	5/32	0.25 - 0.70	24 - 60
4010	4.0	5/32	0.70 - 1.20	14 - 24
4020	4.0	5/32	1.00 - 1.60	10 - 16
5005	5.0	3/16	0.25 - 0.70	24 - 60
5010	5.0	3/16	0.70 - 1.20	14 - 24
5020	5.0	3/16	1.00 - 2.00	9 - 16
6005	6.0	1/4	0.25 - 0.70	24 - 60
6010	6.0	1/4	0.70 - 1.20	14 - 24
6020	6.0	1/4	1.00 - 2.00	9 - 16
8010	8.0	5/16	0.70 - 1.20	14-24
8020	8.0	5/16	1.00 - 2.00	9 - 16
8030	8.0	5/16	1.50 - 3.00	7 - 12

Standard rod lengths: 350mm (14“) and 700mm (28“).
vacuum packaging is available on request



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Welding Tips

BASE METAL

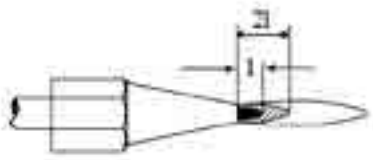
DURMAT® A is suitable for use with all non-alloyed and base alloyed steels or cast steel products with a carbon ratio of up to 0.5 %. If the carbon content is much above this level, bonding errors and a reduction in impact resistance can occur. The consistency of base metal must high enough so as to ensure that the weld deposit does not collapse during application.

PREPARATION OF MATERIAL

First ensure that all surfaces are free from rust, scale, grease and other impurities. The process works best, and thereby guarantees a satisfactory bonding of the alloy, on surfaces which have been polished through mechanical processing or grinding.

WORKING REGULATIONS

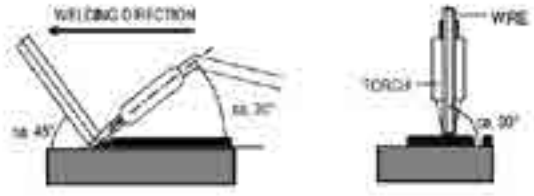
DURMAT® A is oxy-acetylene welded so preliminary heating of the separate components is unnecessary. Larger components, however, for which the required binding temperature of ca. 850 °C cannot be attained, must either be pre-heated in a furnace or else be brought to between 500 - 600 °C (dark red) with a larger welding or pre-heating torch. Choose a welding torch a size of two smaller than is used for ordinary joint welding. The flame should be adjusted to neutral.



To prevent the component from slipping during welding, it should lie as level as possible with the plated surface. The thickness of the deposit can be altered by slightly inclining the surface plane.

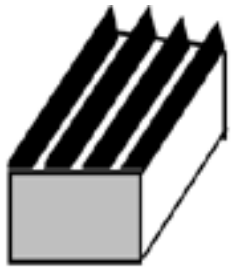
The forehand welding technique is used for application. This method not only prevents the welding material from overheating, but simultaneously preheats the base metal.

The torch should be guided as horizontally as possible to the component being welded – thus ensuring that overheating does not occur. Ideally the "nucleus" of the flame should not come into contact with the welding material.

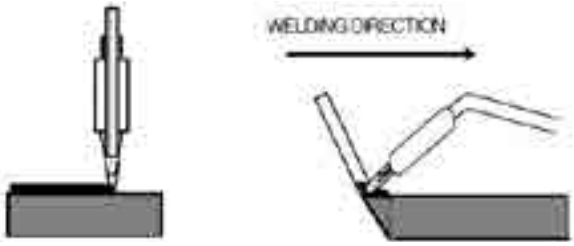


For the facing and mounting of edging work and line-beading a Welding alignment is required. In this way, the welding itself guides both the torch and the rod through the application.

Edge faced with DURMAT® A



Line beading with DURMAT® A



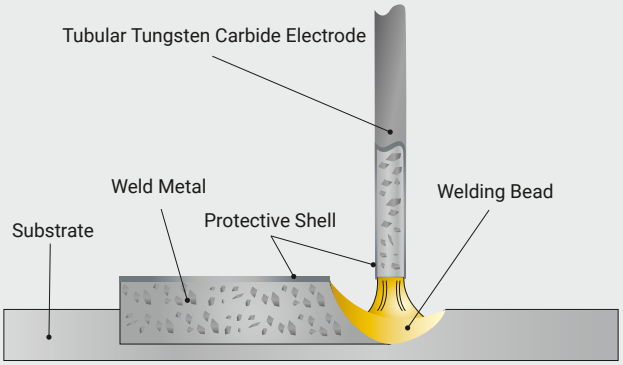
Position of torch and welding direction when facing edge with DURMAT® A

Particular care must be taken during facing not let the rod touch the welding puddle, otherwise the carbide grains will float upwards and be blown away by the welding flame. The welding material should be held as close as possible whilst still allowing tear-shaped droplets to form. Additionally, the rod should be held at an angle not exceeding 30° to the horizontal to ensure that the carbides do not drop of the rod an over-concentrate the initial part of the weld. Careful attention to this procedure will ensure the correct mixing of carbides and matrix throughout the welded length of the rod.

FINISHING

DURMAT® A hard-facing is indifferent to fast cooling, so special-weld treatment is not required. Tempering of the base metal can be done after the facing has been completed without fear of damaging the alloy. Quench hardening is, however, to be avoided. Processing through grinding with either silicon carbide (46 - 80 grain with a hardness of no more than 2) or diamond plate at 20 - 25 m/sec. shall be required later on.

SMAW (Shielded Metal Arc Welding) / MMAW (Manual Metal Arc Welding):



Shielded Metal Arc Welding (SMAW), also known as Manual Metal Arc Welding (MMA or MMAW), Flux Shielded Arc Welding or informally as Stick Welding, is a manual arc welding process that uses a consumable electrode covered with a flux to lay the weld.

An electric current, in the form of either alternating current or direct current from a welding power supply, is used to form an electric arc between the electrode and the metals to be joined. The workpiece and the electrode melts forming a pool of molten metal (weld pool) that cools to form a joint. As the weld is laid, the flux coating of the electrode disintegrates, giving off vapors that serve as a shielding gas and providing a layer of slag, both of which protect the weld area from atmospheric contamination.

Because of the versatility of the process and the simplicity of its equipment and operation, shielded metal arc welding is one of the world's first and most popular welding processes. SMAW is the right process for high quality repairs on parts coated with fused tungsten carbide nickel-matrix alloys like DURMAT® NIFD.

DURMAT® NISE

Stick Electrode DIN EN 14700: E Ni20
(DIN 8555: E21-GF-UM-60-CGZ)

Industry standard for highest wear protection

General characteristics:
DURMAT® NISE is a tubular electrode filled with Fused Tungsten Carbide (FTC) and a special nickel alloy for manual welding. This alloy is specially designed for application where extreme abrasion in combination with corrosion is expected. DURMAT® NISE can be applied on steel castings, nickel based and stainless steel alloys. The alloy combination of DURMAT® NISE is specially designed for surfaces that are exposed to corrosive media and excessive wear conditions. The matrix is highly resistant to acids, lye and other corrosive media.

Typical Hardness:
FTC: ≈ 2,360 $HV_{0.1}$
Ni-Matrix: 480 - 520 $HV_{0.1}$

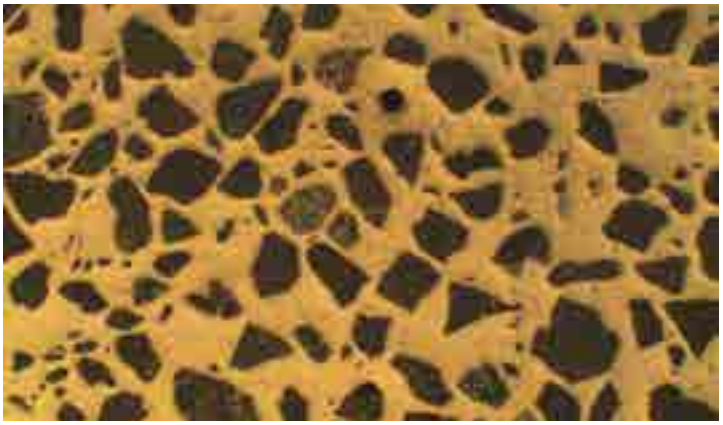
Application:
Repairing and hard-facing ferritic and austenitic steels (steel castings), stabilizer blades, conveyor screws, milling plates, deep drilling tools, and mixer blades. This type of stick electrodes require the least amount of equipment and provides maximum flexibility for welding in remote locations.

Sales units:

Type	Ø mm	Ø inch	Length of Rod	Amps	Voltage
4005	4.0	5/32	350 mm	100 A	= + / ~
5005	5.0	3/16	350 mm	120 A	= + / ~
6005	6.0	1/4	350 mm	160 A	= + / ~
8005	8.0	5/16	450 mm	160 A	= + / ~

vacuum packaging is available on request

Patents:
Germany: No. 40 08 091.9-41
United Kingdom: No. 2.232.108
USA: No. 5.004.886



DURMAT® NISE PLUS

Stick Electrode DIN EN 14700: E Ni20
(DIN 8555: E21-GF-UM-60-CGZ)

Improved Material.

General characteristics:

DURMAT® NISE-PLUS is a tubular electrode filled with Spherical Fused Tungsten Carbide (SFTC) and a special nickel matrix for manual welding. This alloy is specially designed for application against extreme abrasion in combination with corrosion attacks. DURMAT® NISE PLUS can be applied on steel castings, nickel based and stainless steel alloys. The alloy combination of DURMAT® NISE PLUS is specially designed for surfaces that are exposed to corrosive media and excessive wear conditions. The matrix is highly resistant to acids, lye and other corrosive media.

Typical Hardness:

SFTC: > 3,000 $HV_{0.1}$
Ni-Matrix: 480 - 520 $HV_{0.1}$

Application:

Repairing and hard-facing ferritic and austenitic steels (steel castings), stabilizer blades, conveyor screws, milling plates, deep drilling tools, and mixer blades, as well as machine parts in the chemical and food industry.

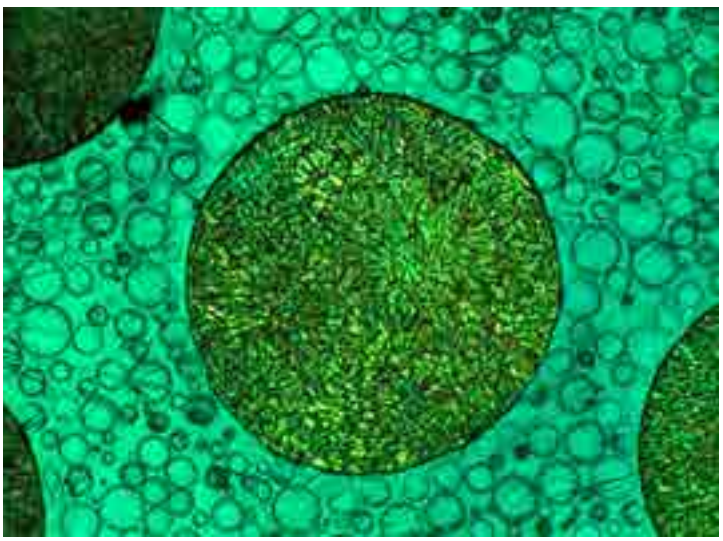
Sales units:

Type	Ø mm	Ø inch	Length of Rod	Amps	Voltage
4005	4.0	5/32	350 mm	100 A	= + / ~
5005	5.0	3/16	350 mm	120 A	= + / ~
6005	6.0	1/4	350 mm	160 A	= + / ~
8005	8.0	5/16	450 mm	160 A	= + / ~

vacuum packaging is available on request

Patents:

Germany: No. 40 08 091.9-41
United Kingdom: No. 2.232.108
USA: No. 5.004.886



Rev. 2.0 (04.2018)

DURMAT® NI-3

Stick Electrode DIN EN 14700: E Ni20
(DIN 8555: E21-GF-UM-60-CGZ)

Improved Material for application with very fine abrasives.

General characteristics:
DURMAT® NI-3 is a tubular electrode filled with a mixture of FTC and special carbides in a combination with a specially developed nickel alloy for manual welding. This alloy is designed for applications where extreme abrasion in combination with corrosion is expected. The alloy combination of DURMAT® NI-3 is specially designed for items that are exposed to corrosive media and excessive wear conditions. The matrix is highly resistant to acids, lye and other corrosive media.

Typical Hardness:
FTC: ≈ 2,360 $HV_{0.1}$
Other carbides: ≈ 2,900 $HV_{0.1}$
Ni-matrix: 480 - 520 $HV_{0.1}$

Application:
Repairing and hard-facing ferritic and austenitic steels (steel castings), stabilizer blades, conveyor screws, milling plates, deep drilling tools, and mixer blades, as well as machine parts in the chemical and food industry.

Sales units:

Type	Ø mm	Ø inch	Length of Rod	Amps	Voltage
4005	4.0	5/32	350 mm	100 A	= + / ~
5005	5.0	3/16	350 mm	120 A	= + / ~
6005	6.0	1/4	350 mm	160 A	= + / ~
8005	8.0	5/16	450 mm	160 A	= + / ~

vacuum packaging is available on request

Patents:
Germany: No. 40 08 091.9-41
United Kingdom: No. 2.232.108
USA: No. 5.004.886

Rev. 2.0 (04.2018)

Application:

DURMAT® NISE electrodes are filled with Fused Tungsten Carbide particles and are used for facing steel or cast steel components that are subject to extreme abrasive wear in the production, preparation or handling of coal, coke, slag, sand, cement, limestone, clay and the like.

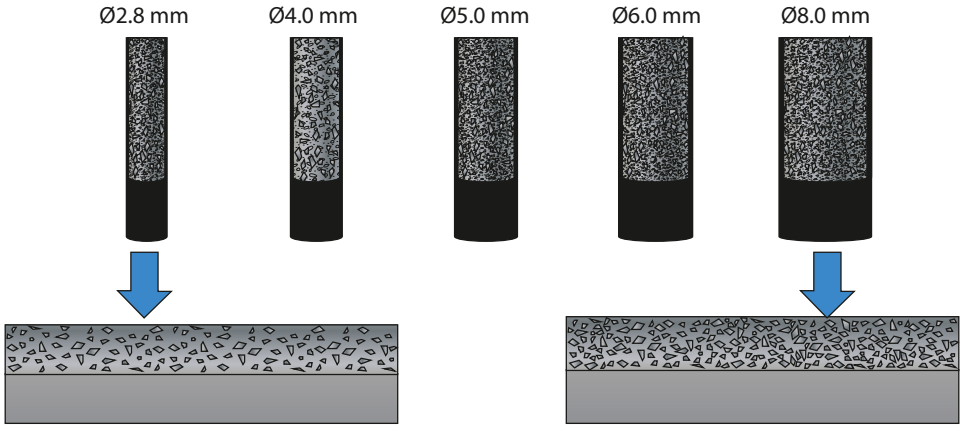
Typical applications are mixer blades, sand mixer ploughs, conveyor and plug mill screws and similar items. Keep in mind, however, that DURMAT® NISE electrodes cannot in all cases be substituted for DURMAT® NIA rods, because the electrically applied deposit does not possess the same high resistance to impact and crushing as the gas applied deposit. DURMAT® NISE is ideally suited for applications where a non-skid surface of deposit is required. They are economical in consumption and should always be deposited in two layers.

Suggestions for electric arc hard-facing:

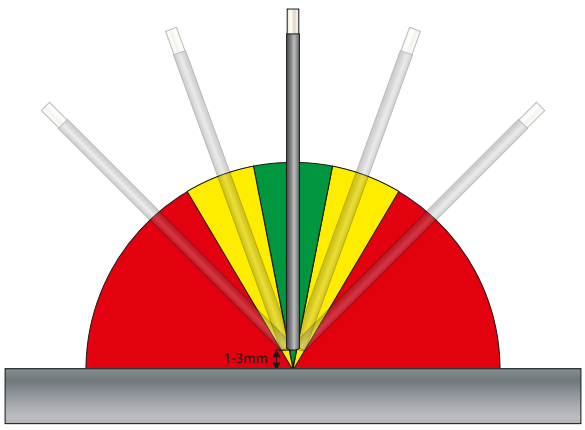
Although small sized components need not be preheated, it is much easier to produce a deposit on them that is free of cracks if they are preheated to about 300 °C and held at this temperature throughout the welding operation.

DURMAT® NISE electrodes can be deposited with alternating current. Best results, however, are achieved with direct current, electrode positive.

The percentage of Fused Tungsten Carbide (FTC) depends on the diameter of the electrode. The larger the diameter of the electrode, the higher the content of Fused Tungsten Carbide, which is evident in the hard-facing layer.



The right welding position of the electrodes during the welding process. The best results are achieved by a vertical position. The best results are achieved by a vertical position an a stickout of 1 - 3 mm.



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DURMAT® CS

General characteristics:
DURMAT® CS consists of sintered tungsten carbide fragments in a ductile Cu-Ni-Zn matrix. The alloy exhibits a tensile strength of 100,000 psi. DURMAT® CS production methods ensure an homogeneous distribution of the sintered tungsten carbide particles. DURMAT® CS composite rods are available in two grades: Wear resistant and cutting.

Application:
Downhole reamers, openers, fishing tools (spears), coring tools, reamers, milling tools and stabilizers.

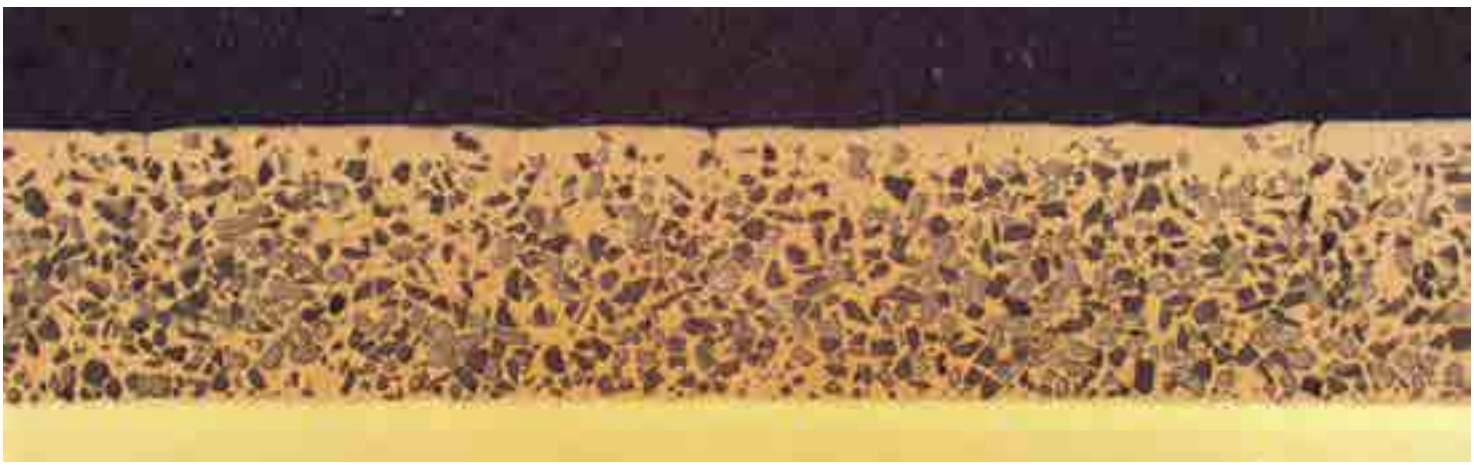
CARBIDE CONTENT:
Standard percentage: 60 %.
Other percentages available are: 40 %, 50 % or 70 %.

Sales units:

Standard composite rod length:	Carbide grain sizes:
450mm (18“)	1/16 x 1/8
450mm (18“)	1/ 8 x 3/16
450mm (18“)	3/16 x 1/4
450mm (18“)	1/4 x 5/16
450mm (18“)	5/16 x 1/2

Other grain sizes are available on request.
vacuum packaging is available on request

DURMAT® Grain Size	TYPICAL CHEMICAL COMPOSITION (wt.-%) TYPICAL APPLICATIONS							HARDNESS	TYPICAL PROPERTIES
	Mix	C	Si	B	Cr	Ni	W		
40 - A -106/+22	-	0.35	3.8	1.6	9 - 10	Bal.	-	35 - 39 HRC	•Resistant to corrosion, abrasion and heat •Excellent gliding on high tensile strength steels and plastics •High wear and heat resistant up to 550 °C
	On small areas or die edges, mold castings in the glass industry, fittings, pistons and guides, buffer layers in addition to DURMAT® B hard-facings								
60 - A -106/+22	-	0.8 - 1	3.8	3.3	16 - 17	Bal.	-	56 HRC	•Resistant to corrosion, abrasion and heat •Excellent gliding on high tensile strength steels and plastics •Rust and acid resistant, cavitation and corrosion resistant
	On small areas or die edges, mold castings in the glass industry, fittings, pistons and guides, buffer layers in addition to DURMAT® B hard-facings								
40 - FTC -106/+22	**Matrix 60**	0.8 - 1	3.8	3.3	16 - 17	-	0.8-1	DURMAT® 60-A: ≈ 56 HRC DURMAT® FTC: >2,360 $HV_{0.1}$	•Resistant to corrosion, abrasion and heat •High wear and heat resistant up to 550 °C •Rust and acid resistant
	FTC 40	3.8 - 4.1	-	-	-	-	Bal.		
	Mechanical engineering, pump and mill construction, the manufacturing of petrochemical apparatus, deep drilling tools, wear plates in agriculture								
50 - FTC -106/+22	**Matrix 50**	0.8 - 1	3.8	3.3	16 - 17	-	0.8 - 1	DURMAT® 60 - A: ≈ 56 HRC DURMAT® FTC: > 2,360 $HV_{0.1}$	•Resistant to corrosion, abrasion and heat •High wear and heat resistant up to 550 °C •Rust and acid resistant
	FTC 50	3.8 - 4.1	-	-	-	-	Bal.		
	Mechanical engineering, pump and mill construction, the manufacturing of petrochemical apparatus, deep drilling tools, wear plates								
60 - FTC -106/+22	**Matrix 40**	0.8 - 1	3.8	3.3	16 - 17	-	0.8 - 1	DURMAT® 60 - A: ≈ 56 HRC DURMAT® FTC: > 2,360 $HV_{0.1}$	•Resistant to corrosion, abrasion and heat •High wear and heat resistant up to 550 °C •Rust and acid resistant
	FTC 60	3.8 - 4.1	-	-	-	-	Bal.		
	Mechanical engineering, pump and mill construction, the manufacturing of petrochemical apparatus, deep drilling tools, wear plates								
75 - FTC -106/+22	**Matrix 25**	0.8 - 1	3.8	3.3	16 - 17	-	0.8 - 1	DURMAT® 60 - A: ≈ 56 HRC DURMAT® FTC: > 2,360 $HV_{0.1}$	•Resistant to corrosion, abrasion and heat •High wear and heat resistant up to 550 °C •Rust and acid resistant
	FTC 75	3.8 - 4.1	-	-	-	-	Bal.		
	Mechanical engineering, pump and mill construction, the manufacturing of petrochemical apparatus, deep drilling tools, wear plates								
80 - FTC -106/+22	**Matrix 20**	0.8 - 1	3.8	3.3	16 - 17	-	0.8 - 1	DURMAT® 60 - A: ≈ 56 HRC DURMAT® FTC: > 2,360 $HV_{0.1}$	•Resistant to corrosion, abrasion and heat •High wear and heat resistant up to 550 °C •Rust and acid resistant
	FTC 80	3.8 - 4.1	-	-	-	-	Bal.		
	Mechanical engineering, pump and mill construction, the manufacturing of petrochemical apparatus, deep drilling tools, wear plates								



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DURMAT® 352 (NiCrBSi + FTC)

General characteristics:

DURMAT® 352 is rust and acid durable, resistant to heavy abrasion and heat. Due to the high FTC-content, the powder is heavy mechanical and mineral wear resistant. Typical application are in mechanical engineering, pump and mill construction, the manufacturing of petrochemical apparatus, deep drilling tools, wear plates in agriculture. Similar to DURMAT® 351 but higher FTC-content.

Typical chemical composition of weld metal (Wt-%):

	C	Si	Cr	Ni	W	B
40 % Matrix	0.8 - 1	3.8	16 - 17	Bal.	0.8 - 1	3.3
60 % FTC	3.9 - 4.1	-	-	-	Bal.	-

Density:

Matrix: 7.8 - 8.1 g/cm³
FTC: 16.0 - 17.0 g/cm³

Particle Size Range in µm:

-125 +45
-90 +45
-45 +22
-25 +5

Hardness:

FTC: > 2,360 $HV_{0.1}$
Matrix: ~ 56 HRC

Melting Point:

Matrix: 1,070 °C, FTC: 2,860 °C

DURMAT® 372

General characteristics:

DURMAT® 372 is rust and acid durable, resistant to heavy abrasion and heat. DURMAT® 372 coatings are very dense and resist wear by abrasive grains or particle erosion / abrasion. Fretting resistant up to 540 °C (1,000 °F).

Typical chemical composition of weld metal (Wt-%):

	C	Si	Cr	Ni	W	B	Co	Fe
60 % Matrix	0.8 - 1	3.8	16 - 17	Bal.	-	3.3	-	-
40 % D® 101	4.8 ± 0.7	-	-	≤ 0.6	Bal.	-	12 ± 1	≤ 2

Density:

Matrix: 7.8 - 8.1 g/cm³

Particle Size Range in µm:

-125 +45
-106 +45
-90 +45

Hardness:

Matrix: ~ 56 HRC

Melting Point:

Matrix: 1,070 °C

Apparent density:

WC-Co: 4.3 - 5.4 g/cm³

Overview: Tungsten Carbide Hard-facing Alloys

Nickel based Hard-facing Alloys:				
Product		**Carbode Type**	**DIN 8555**	**DIN EN 14700**
DURMAT® B	Welding Rod	DURMAT® FTC	G21-UM-55-CG	T Ni20-CGTZ
DURMAT® BK-SPHERICAL	Welding Rod	DURMAT® SFTC	G21-UM-55-CG	T Ni20-CGTZ
DURMAT® NISE	Stick Electrode	DURMAT® FTC	E21-GF-UM-60-CGZ	E Ni20-CGTZ
DURMAT® NISE PLUS	Stick Electrode	DURMAT® SFTC	E21-GF-UM-60-CGZ	E Ni20-CGTZ
DURMAT® NI-3	Stick Electrode	DURMAT® FTC + SC	E21-G F-UM-60-CGZ	E Ni20-CGTZ
DURMAT® NIFD	Flux-Cored Wire	DURMAT® FTC	MF21-55-CGZ	T Ni20-CGTZ
DURMAT® NIFD PLUS	Flux-Cored Wire	DURMAT® SFTC	MF21-55-CGZ	T Ni20-CGTZ
DURMAT® NICRW	Flux-Cored Wire	DURMAT® FTC	MF21-55-CGZ	T Ni20-CGTZ
DURMAT® NI-2	Flux-Cored Wire	DURMAT® FTC + SC	MF21-60-CGZ	T Ni20-CGTZ
DURMAT® NI-2 PLUS	Flux-Cored Wire	DURMAT® SFTC + SC	MF21-60-CGZ	T Ni20-CGTZ
DURMAT® FD 773	Flux-Cored Wire	DURMAT® RF 13	MF21-55-CGZ	T Ni20
DURMAT® FD 778	Flux-Cored Wire	DURMAT® FTC	MF21-55-CGZ	T Ni20
DURMAT® FD 779	Flux-Cored Wire	DURMAT® MCWC	MF21-55-CGZ	T Ni20
DURMAT® FD 780	Flux-Cored Wire	DURMAT® MCWC	MF21-55-CGZ	T Ni20
DURMAT® FD 789	Flux-Cored Wire	DURMAT® RF 13	MF21-55-CGZ	T Ni20

Iron based Hard-facing Alloys:				
Product			**DIN 8555**	**DIN EN 14700**
DURMAT® OA	Flux-Cored Wire	DURMAT® FTC	MF21-65-CG	T Fe20
DURMAT® E	Stick Electrode	DURMAT® FTC	MF21-65-CG	E Fe20
DURMAT® E - PLUS	Stick Electrode	DURMAT® SFTC	MF21-65-CG	E Fe20
DURMAT® A	Welding Rod	DURMAT® FTC	MF21-65-CG	T Fe20
DURMAT® A - PLUS	Welding Rod	DURMAT® SFTC	MF21-65-CG	T Fe20

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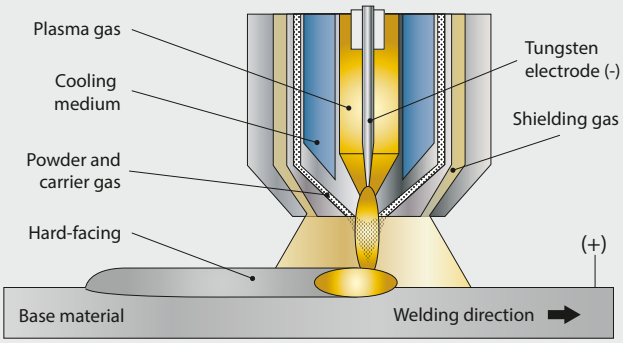
Plasma Tranferred Arc Welding



DURUM's family of Tungsten Carbide - Nickel base alloys exhibit superior resistance to abrasion and wear, retaining their hardness up to 600 °C (approx. 1,000 °F) in combination with excellent corrosion resistant properties.

PTA - Plasma Transferred Arc is suitable for almost all cobalt and nickel based alloys as well as specially designed iron based alloys. Primary carbides in combination with those nickel, cobalt and iron based alloys improve the wear resistance remarkably compared to chromium carbide plates.

PTA is a true welding process, with deposits forming a metallurgical bond with the base metal. The dilution level is very close to those obtained by using the oxy-acetylene process.

A further advantage of using the PTA process is the capability of producing thin edge surfaces. Together with the very low dilution (approx. 5 %) and the minimal distortion risk, the process is ideal for applications on parts such as Fan Blades.

DURMAT® Laser-Like Overlays

Today we have a world-class solution developed for every aspect of wear typically encountered throughout the oil and gas industry that meets and exceeds the customer expectations.

For over 25 years we have engineered a broad range of wear solution products for a large variety of applications including:

- Specially created smooth "casing-friendly" overlays for tool-joints operating in cased holes and incredibly wear resistant overlays for the most challenging open-hole conditions;
- Specialised products for the manufacture of PDC and Tricone Bits;
- New, highly automated PTA stabiliser hard-facings that are more than a match for traditional, manually built "thermal" dressings (as proven in recent tool-for-tool trials under real down-hole conditions);
- Comprehensive wear-protection solutions for Thermal Cuttings Treatment mills, now adopted as "manufacturer specification".

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DURMAT® 61 PTA

PTA Welding Powders

General characteristics:
DURMAT® 61 PTA is corrosion resistant and acid durable, resistant to heavy abrasion and heat. Due to the high tungsten carbide content, the powder is very wear resistant. DURMAT® 61 PTA protects components that are exposed to heavy mechanical and mineral wear.

Typical chemical composition of weld metal (Wt-%):

DURMAT® 59 PTA	DURMAT® FTC
40	60

Hardness:

Matrix: 50 - 55 HRC
DURMAT® FTC: > 2,360 $HV_{0,1}$

Melting point:

Matrix: 1,070 °C / 1,958 °F
DURMAT® FTC: 2,860 °C / 5,180 °F

Density:

Matrix: 8.1 g/cm³
DURMAT® FTC: 16 - 17 g/cm³

Structure:

Ni-Matrix with FTC and Ni-Boride

Grain Size:

-160 +63 µm

DURMAT® 62 PTA

PTA Welding Powders

General characteristics:
DURMAT® 62 PTA is corrosion resistant and acid durable, resistant to heavy abrasion and heat. Due to the high spherical tungsten carbide content, the powder is extremely wear resistant. DURMAT® 62 PTA protects components that are exposed to heavy mechanical and mineral wear.

Typical chemical composition of weld metal (Wt-%):

DURMAT® 59 PTA	DURMAT® SFTC
40	60

Hardness:

Matrix: 50 - 55 HRC
DURMAT® SFTC: > 3,000 $HV_{0.1}$

Melting point:

Matrix: 1,070 °C / 1,958 °F
DURMAT® SFTC:> 2,860 °C / 5,180 °F

Density:

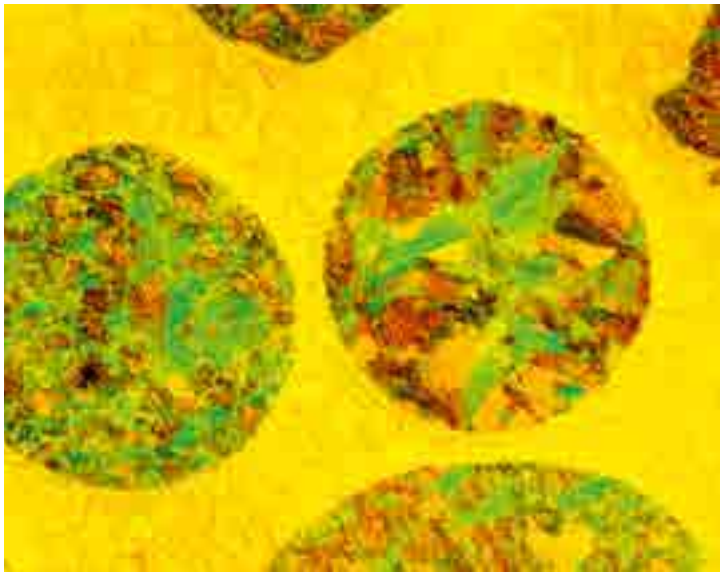
Matrix: 8.1 g/cm³
DURMAT® SFTC: 16 - 17 g/cm³

Structure:

Ni-Matrix with SFTC and Ni-Boride

Grain Size:

-160 +63 µm



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DURMAT® 93 PTA

PTA Welding Powders

General characteristics:
DURMAT® 93 PTA is corrosion resistant, acid durable, resistant to heavy abrasion and heat. Due to the high Special Tungsten Carbide Combination content, the powder is extremely wear resistant. DURMAT® 93 PTA protects components that are exposed to heavy mechanical and mineral wear.

Typical chemical composition (in wt-%)*:
DURMAT® 59 PTA + Special Tungsten Carbide Combination

Hardness:

Matrix:	50 - 55 HRC
Tungsten Carbide Combination:	2,360 - 3,000 $HV_{0.1}$

Melting point:

Matrix:	1,070 °C / 1,958 °F
Tungsten Carbide Combination:	2,860 °C / 5,180 °F

Density:

Matrix:	8.1 g/cm³
Tungsten Carbide Combination:	16 - 17 g/cm³

Structure:
Ni-Matrix with Special Tungsten Carbide Combination and Ni-Borid.

Grain Size:
-160 +63 µm

DURMAT® 59 PTA

PTA Welding Powders

General characteristics:
DURMAT® 59 PTA is resistant to heavy abrasion and heat. Its extreme hardness allows for excellent sliding on high tensile strength steels. DURMAT® 59 PTA is also recommended in combination with fused tungsten carbide (FTC) for wear resistant applications.

Typical chemical composition of weld metal (Wt-%):

C	Si	Ni	B	Fe
0.02	3.0	Bal.	3.0	< 2

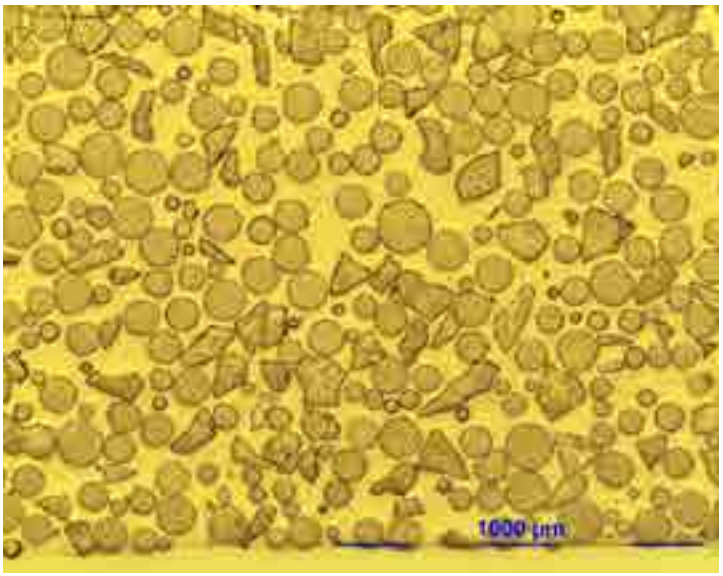
Hardness:
50 - 55 HRC

Melting point:
1,070 °C / 1,958 °F

Density:
8.1 g/cm³

Structure:
Ni-Matrix / Ni-Boride

Grain Size:
-160 +63 µm



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PTA Powders

DURMAT®	Typical chemical Composition of Matrix (in Wt.-%)													Typical Properties
	C	Si	Mn	Cr	B	Ni	Mo	Co	Nb	V	W	Fe	+	
33 PTA	-	4.1	-	6	1	bal.	-	-	-	-	-	1.5	-	•NiSF-Alloy. Gas atomized. •Special powder for glass industry •Hardness NiSF: 33 HRC
38 PTA	<0.1	2.5- 3.5	-	6	1.8-2.4	bal.	-	-	-	-	-	<0.5	-	•NiSF-Carbide. Blend. **•Mix: 70% Matrix + 30% FTC** •Heat, corrosion and abrasion resistant •Hardness NiSF: 40 HRC
52 PTA	0.05 -0.15	0.3-0.4	2.7-3.3	12.5- 13.5	-	bal.	-	-	2.2-2.7	-	-	0.8-1.2	-	•NiSF-Alloy. Gas atomized. •Abrasion and friction resistant •Corrosion resistant
54 PTA	0.5-0.7	3.5-4.5	-	15-17	3-4	bal.	2-4	-	-	-	-	<3	Cu: 2-3	•NiSF-Alloy. Gas atomized. •Heat, corrosion and abrasion resistant •Hardness: 56 - 61 HRC
55 PTA	0.4-0.6	3.5-4.5	-	12-14	2.5-3.5	bal.	-	-	-	-	-	3.5-4	-	•NiSF-Alloy. Gas atomized. •Heat, corrosion and abrasion resistant •Hardness: 50 - 55 HRC
56 PTA	0.25	3.2	-	7.5	1.8	bal.	-	-	-	-	-	<2.5	-	•NiSF-Alloy. Gas atomized. •Heat, corrosion and abrasion resistan •Low friction •Hardness: 40 HRC
57 PTA	0.9-1.1	4	-	15-17	3.2	bal.	-	-	-	-	-	3.4	-	•NiSF-Alloy. Gas atomized. •Heat, corrosion and abrasion resistant •Low friction •Hardness: 58 - 60 HRC
58 PTA	0.75	4.3	-	15	3.1	bal.	-	-	-	-	-	3.5	-	•NiSF-Alloy. Gas atomized. •Heat, corrosion and abrasion resistant •Low friction •Hardness: 50 - 52 HRC
59 PTA	0.02	3	-	-	3	bal.	-	-	-	-	-	<2	-	•NiSF-Alloy. Gas atomized. •Heat, corrosion and abrasion resistant •Hardness: 50-52 HRC
61 PTA	0.02	3	-	-	3	bal.	-	-	-	-	-	<2	-	•NiSF-Carbide. Blend. **•DURMAT® 59 PTA: 40 % + FTC: 60 %** •Heat, corrosion and abrasion resistant

FTC - Fused Tungsten Carbide, SFTC - Spherical Fused Tungsten Carbide, SC - Special Carbide, MCWC - Macro-Crystalline Tungsten Carbide

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PTA Powders

DURMAT®	Typical chemical Composition of Matrix (in Wt.-%)													Typical Properties
	C	Si	Mn	Cr	B	Ni	Mo	Co	Nb	V	W	Fe	+	
62 PTA	0.02	3	-	-	3	bal.	-	-	-	-	-	<2	-	•NiSF-Carbide. Blend. **•DURMAT® 59 PTA: 40 % + SFTC: 60 %** •Heat, corrosion and abrasion resistant
63 PTA	0.25	3.2	-	7.5	1.8	bal.	-	-	-	-	-	<2.5	-	•NiSF-Carbide. Blend. **•DURMAT® 56 PTA: 40 % + SFTC: 60 %** •Heat, corrosion and abrasion resistant
65 PTA	0.75	4.3	-	15	3.1	bal.	-	-	-	-	-	3.5	-	•NiSF-Carbide. Blend. •Heat, corrosion and abrasion resistant **•DURMAT® 58 PTA: 40 % + FTC: 60 %**
66 PTA	0.4	5-5.5	-	22 - 25	1.7-2	bal.	-	-	-	-	-	-	-	•NiSF-Carbide. Blend. •Heat, corrosion and abrasion resistant •Hardness Matrix: 50 HRC **•Special Carbides: 10 - 15 %**
67 PTA	0.02	3	-	-	3	bal.	-	-	-	-	-	<2	-	•NiSF-Carbide. Blend. •Heat, corrosion and abrasion resistant **•DURMAT® 59 PTA: 35 - 40 %** **•FTC: 55 - 60 %, < 8 % Special Carbides**
68 PTA	0.02	3	-	-	3	bal.	-	-	-	-	-	<2	-	•NiSF-Carbide. Blend. •Heat, corrosion and abrasion resistant **•DURMAT® 59 PTA: 35 - 40 %** **•SFTC: 56 - 60 %, < 8 % Special Carbides**
71 PTA	0.05	3	-	-	3	bal.	-	-	-	-	-	<30	-	•Heat and corrosion resistant •High abrasion resistance **•DURMAT® 77 PTA: 40 % + FTC: 60 %**
72 PTA	0.05	3	-	-	3	bal.	-	-	-	-	-	<30	-	•NiSF-Carbide. Blend. •Heat and corrosion resistant •High abrasion resistance **•DURMAT® 77 PTA: 40 % + SFTC: 60 %**
73 PTA	0.05	3	-	-	3	bal.	-	-	-	-	-	<30	-	•NiSF-Carbide. Blend. •Heat and corrosion resistant •High abrasion resistance **•DURMAT® 77 PTA: 40 + MCWC: 60 %**
74 PTA	20-24	<0.1	-	-	3.5	bal.	-	-	-	-	-	<5	-	•NiSF-Carbide. Blend. •Heat, corrosion and abrasion resistant **•NiSF-Matrix: 40 %** **•FTC: 50 %, < 10% Special Carbides**
77 PTA	0.05	3	-	-	3	bal.	-	-	-	-	-	<30	-	•Ni-Alloy. Gas atomized. •Heat and corrosion resistant •High abrasion resistance •Hardness: 50 - 55 HRC
79 PTA	0.9-1.1	4	-	15-17	3.2	bal.	-	-	-	-	-	3.4	-	•NiSF-Carbide . Blend. •Heat and corrosion resistant •High abrasion resistance **•DURMAT® 57 PTA: 40 % + FTC: 60 %**
84 PTA	-	4.1	-	6	1	bal.	-	-	-	-	-	1.5	-	•NiSF-Carbide. Blend. •Heat and corrosion resistant •High abrasion resistance **•DURMAT® 33 PTA: 40 % + MCWC: 60 %**
85 PTA	0.75	4.3	-	15	3.1	bal.	-	-	-	-	-	3.5	-	•NiSF-Carbide. Blend. •Heat and corrosion resistant •High abrasion resistance **•DURMAT® 58 PTA: 40 % + MCWC: 60 %**
93 PTA	0.02	3	-	-	3	bal.	-	-	-	-	-	<2	-	•NiSF-Carbide. Blend. •Heat, corrosion and abrasion resistant **•DURMAT® 59 PTA: 40 %** **•Special Carbides (SC): 60 %**

FTC - Fused Tungsten Carbide, SFTC - Spherical Fused Tungsten Carbide, SC - Special Carbide, MCWC - Macro-Crystalline Tungsten Carbide

PTA Powders

DURMAT®	Typical chemical Composition of Matrix (in Wt.-%)													Typical Properties
	C	Si	Mn	Cr	B	Ni	Mo	Co	Nb	V	W	Fe	+	
108 PTA	0.4	-	15-16	14-15	-	1.2	-	-	-	-	-	bal.	-	•FeCr-Carbide. Blend. •High abrasion and friction resistance •Hardness Matrix : 250HB **•40% Matrix + 60 % Granulat WC-Co 94-6**
109 PTA	<0.1		6-7	18-19	-	9	-	-	-	-	-	bal.	-	•FeCr-Carbide. Blend. •High abrasion and friction resistance •Hardness Matrix : 170HB **•40% Matrix + 60 % Granulat WC-Co 94-6**
110 PTA	0.25	3.2	-	7.5	1.8	bal.	-	-	-	-	-	<2.5	-	•NiSF-Carbide. Blend. •High abrasion and friction resistance •Hardness Matrix : 40 HRC **•40% Matrix + 60 % Granulat WC-Co 94-6**
401 PTA	<0.1	-	-	20-24	-	bal.	8-9	<4	3.5	<5	-	<5	-	•Ni-Carbide. Blend. •High heat, corrosion, abrasion resistance **•50% Matrix** **•50% Carbide (FTC and SC mixture)**
411 PTA	<0.1	-	-	20-24	-	bal.	8-9	<4	3.5	<5	-	<5	-	•Ni-Carbide. Blend. •High heat, corrosion, abrasion resistance **•50% Matrix** **•50% Carbide (FTC and SC mixture)**
470 PTA	-	2.75	-	4	1	-	-	-	-	-	-	-	5	•Ni-Carbide. Blend. •Heat and corrosion resistant •Hardness: 33 HRC
505 PTA	2.5-2.8	-	-	<7	-	-	1-1.25	-	-	-	-	bal.	-	•Fe- Alloy. Gas Atomized. •Heavy impact and abrasion resistant **•Fine Special Carbides (10 - 12 %)** •Hardness: 55 - 60 HRC.
506 PTA	3.1	-	-	<9	-	-	1.5-1.8	-	-	-	-	bal.	-	•Fe- Alloy. Blend. •Heavy impact and abrasion resistant **•Fine Special Carbides (18 %)** •Hardness: 60 - 62 HRC
507 PTA	3.1	-	-	<9	-	-	1.3-1.8	-	-	-	-	bal.	-	•Fe- Alloy. Blend. •Heavy impact and abrasion resistant **•Fine Special Carbides (20 %)** •Hardness: 60 - 65 HRC
516 PTA	0.03	-	-	18	-	13	3	-	-	-	-	bal.	-	•Fe-Alloy. Gas Atomized. •Austenitic metal •Pitting corrosion and intercrystalline corrosion resistant. T_{MAX} = 400 °C.
520 PTA	<0.1	-	6-7	18-19	-	9	-	-		-	-	bal.	-	•Fe-Alloy. Gas Atomized. •Austenitic weld metal •Corrosion resistant
525 PTA	0.4	-	15-16	14-15	-	1.2	-	-	-	-	-	bal.	-	•Fe-Alloy. Gas Atomized. •Austenitic weld metal •Corrosion resistant •Thermal shock resistant up to 850 °C
530 PTA	0.3	0.4	-	12	-	-	1.3	1.5	-	1	-	bal.	-	•Fe-Alloy. Gas Atomized. •Corrosion resistant •Abrasion resistant •Hardness: 47 - 52 HRC
531 PTA	0.03	0.7	1.2	22	-	5.5	3.3	-	-	-	-	bal.	-	•Fe-Alloy. Gas Atomized. •Weld metal with low carbon •Corrosion resistant
536 PTA	1	-	-	4.2	-	-	5	-	-	2	6.4	bal.	-	•Fe-Alloy. Gas Atomized. •Corrosion and abrasion resistant •Fine carbide microstructure •Hardness: 58 HRC

FTC - Fused Tungsten Carbide, SFTC - Spherical Fused Tungsten Carbide, SC - Special Carbide, MCWC - Macro-Crystalline Tungsten Carbide

Rev. 2.0 (04.2018)

DURMAT®	Typical chemical Composition of Matrix (in Wt.-%)													Typical Properties
	C	Si	Mn	Cr	B	Ni	Mo	Co	Nb	V	W	Fe	+	
541 PTA	2.6	1	1	25	-	0.4	-	-	-	-	-	bal.	-	•Fe-Alloy. Gas Atomized. •Corrosion and abrasion resistant •Fine carbide microstructure •Hardness: 52 - 55 HRC
559 PTA	4	1.5	-	32	1	-	-	-	-	-	-	bal.	-	•Fe-Alloy. Gas Atomized. •Corrosion and abrasion resistant •CrC microstructure •Hardness: 59 - 62 HRC
560 PTA	0.7	2	-	8	-	-	-	-	-	-	-	bal.	-	•Fe-Alloy. Gas Atomized. •Medium abrasion and corrosion resistant •Suitable for impact wear •Hardness: 53 - 55 HRC
564 PTA	3.8	-	-	22	1	-	-	-	-	0.8	0.8	bal.	-	•Fe-Alloy. Gas Atomized. •Abrasion resistant •Hardness: 62 - 64 HRC
601 PTA	0.2-0.6	-	-	4.0-6.0	-	-	1-1.6	-		0.5-1.5	-	bal.	-	•Fe-Alloy. Gas Atomized. •Crack and tempering resistant •Suitable for impact wear conditions •Hardness: 58 HRC
625 PTA	0.05	-	-	21	-	bal.	9.2	-	3.5	-	-	3	-	•Ni-Alloy. Gas Atomized. •High corrosion resistance (in acids with chloride content and sea water) •Hardness: 210 HV
4370 PTA	0.1	0.9	7	19	-	9	-	-	-	-	-	bal.	-	•Fe-Alloy. Gas Atomized. •Corrosion resistant •T_{MAX} = 850 °C •Hardness: 350 HV
4462 PTA	1	-	-	4.5	-	-	5	-	-	2	6.5	bal.	-	•Fe-Alloy. Gas Atomized. •DSS weld metal with low carbon •Corrosion resistant

FTC - Fused Tungsten Carbide, SFTC - Spherical Fused Tungsten Carbide, SC - Special Carbide, MCWC - Macro-Crystalline Tungsten Carbide

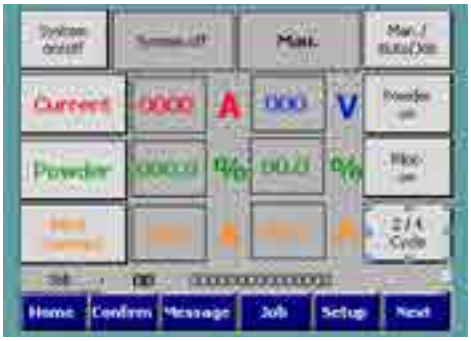
Co-based PTA Powders

S1 PTA	2.5	1.1	-	30	-	-	-	bal.	-	-	12	-	-	•Co-Alloy. Gas Atomized. •Abrasion, corrosion, friction resistant •T_{MAX} = 750 °C •Hardness: 55 HRC
S6 PTA	1	1.2	-	28	-	-	-	bal.	-	-	4.2	-	-	•Co-Alloy. Gas Atomized. •Abrasion, corrosion, friction resistant •T_{MAX} = 750 °C •Hardness: 42 HRC
S12 PTA	1.4	1.2	-	27	-	<1	-	bal.	-	-	8	<1	-	•Co-Alloy. Gas Atomized. •Abrasion, corrosion, friction resistant •T_{MAX} = 750 °C •Hardness: 46 HRC
S21 PTA	-	0.5	-	26	-	1-3	5.2	bal.	-	-	-	-	-	•Co-Alloy. Gas Atomized. •Friction and temperature resistanct •Buffer layer for thick Stellite coatings •Hardness: 23 HRC
S190 PTA	3-3.5	1	1	24-28	-	3	-	bal.	-	-	12-16	5	-	•Co-Alloy. Gas Atomized. •Heat and corrosion resistant •Friction and temperature resistanct •Hardness: 54 - 58 HRC

DURWELD 250T PTA

As a result of customer requests we have introduced a new durable, reliable, and affordable mobile PTA machine into the market. The system is designed for ease of automation into heavy-duty industrial environments.

Developed and manufactured by DURUM in Germany. This mobile and cost-efficient plasma powder welding system DURWELD 250T PTA is PLC-controlled, equipped with a HMI-interface and a separate water cooling unit. Gas flows are controlled by manual gas flow meters. The main inverter power source is primary-switched and generates a very stable arc that ensures consistent and repeatable coatings.



Typical program design

Pilot arc current*:	2 - 20 A (100 % Duty Cycle)
Main arc current*:	5 - 280 A (180 A 100 % Duty Cycle)
Voltage supply*:	3 x 400 V + N ±10 %
Supply frequency*:	50 / 60 Hz
Supply fuse*:	32 A
Degree of protection:	IP 23
Plasma gas adjustment:	Manual gas flow meter, 0.2 - 15 l/min
Shielding gas adjustment:	Manual gas flow meter, 0.2 - 15 l/min
Transport gas adjustment:	Manual gas flow meter, 0.2 - 15 l/min
Recommended (max) gas inlet:	1 bar (1.5 bars)
Dimensions (W x D x H):	60 x 100 x 120 cm (without powder feeder)
Chiller Unit:	4.5 kW cooling capacity

* Depending on the user country electric datas can differ!

Job Control

Automation setup and control is handled by user friendly, industrial strength touch screen panel. The main screen gives access to all relevant welding parameters. The integrated job management provides, apart from recipe storage, the possibility to fix all critical parameters in the jobs. This way you can create your specific recipes tailored to your welding jobs. An optional automation interface is available.

PLC-controlled

The use of a modern PLC system provides reliable operation and allows the easy integration in automatic production lines or robot cells.

HMI-Interface

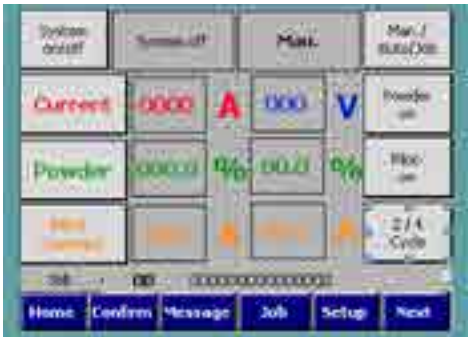
The intuitive menu structure and the combination of a touch screen with haptic controls provides easy operation. The HMI-interface is also available as a mobile version which is ideal for remote operation and monitoring tasks.

Rev. 2.0 (04.2018)

DURWELD 400T PTA

Made by DURUM in Germany. This new high performance PTA welding system DURWELD 400T PTA is the latest DURUM development of Plasma Welding Units for industrial applications.

The mobile plasma powder welding system is PLC-controlled and equipped with a HMI-interface, gas mass flow meters and a separate 4.5 kW water cooling system. Based on a 400 Amps** welding inverter our DURWELD 400T offers a powerful and reliable power source. The main inverter power source is primary-switched and generates a very stable arc which ensures consistent and repeatable coatings.



Typical program design

Pilot arc current*:	2 - 20 A (100 % Duty Cycle)
Main arc current*:	5 - 400** A (250 A 100 % Duty Cycle)
Voltage supply*:	3 x 400 V + N ±10 %
Supply frequency*:	50/60 Hz
Supply fuse*:	32 A
Degree of protection:	IP 23
Plasma gas adjustment:	Mass flow meter, 0.2 - 15 l/min
Shielding gas adjustment:	Mass flow meter, 0.2 - 15 l/min
Transport gas adjustment:	Mass flow meter, 0.2 - 15 l/min
Recommended (max) gas inlet:	1 bar (1.5 bars)
Dimensions (W x D x H):	75 x 120 x 130 cm (without powder feeder)
Chiller Unit:	4.5 kW

* Depending on the user country electric datas can differ! ** at 20% Duty Cycle!

Job Control

Automation setup and control is handled by a user friendly, industrial strength touch screen panel. The main screen gives access to all relevant welding parameter. The integrated job management provides, apart from recipe storage, the possibility to fix all critical parameters in the jobs. This way you can create your specific recipes tailored to your welding jobs. Optional automation interface is available.

PLC-controlled

The use of a modern PLC system provides reliable operation and allows the easy integration in automatic production lines or robot cells.

HMI-Interface

The intuitive menu structure and the combination of a touch screen with haptic controls provides easy operation. The HMI-interface is also available as a mobile version which is ideal for remote operation and monitoring tasks.

DURMAT® PT 150M

The plasma-powder-welding torch DURMAT® PT 150M is designed for manual hard-facing of small areas. The torch is light and handy, allowing deposition rates up to 1,8 kg/h. The shielding gas nozzle is made from ceramic, so short circuits can be avoided. The non melting electrodes are generally tungsten electrodes with oxide additions. The standard length of the tube package is 4 m. Longer tube packages are available on request. Optional a foot pedal is available to adjust welding current.

Construction:	Manual hand held torch
Max current:	150 A
Powder flow rate:	Max. 30 g/min (depending on powder density)
Description:	Water cooled hand-held torch

DURMAT® PT 300M

The plasma-powder-welding torch DURMAT® PT 300M is designed for manual hard-facing with higher deposion rate up to 3 kg/h. The torch is strong and handy and shows excellent properties with high lifespan under rough industrial working conditions. The shielding gas nozzle is made from ceramic, so short circuits can be avoided. The non melting electrodes are generally tungsten electrodes with oxide additions. The standard length of the tube package is 4 m. Longer tube package are available on request. Optional a foot pedal is available to adjust welding current.

Construction:	Manual hand held torch
Max current:	300 A
Powder flow rate:	Max. 50 g/min (depending on powder density)
Description:	Water cooled hand-held torch

Rev. 2.0 (04.2018)

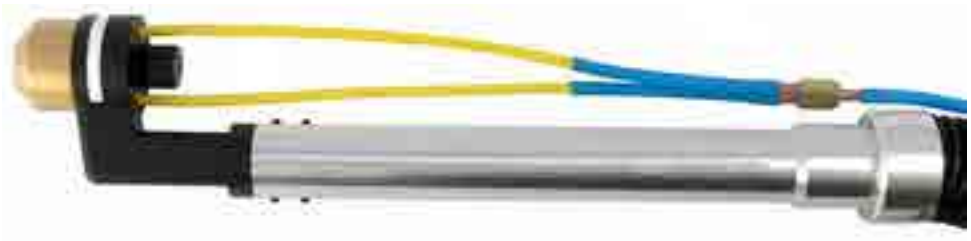
DURMAT® PT 300AUT

The plasma-powder-welding torch DURMAT® PT 300AUT has the same construction like the hand-held torch PT 300M, but is designed for semi-automatic or automatic welding with welding manipulators or robots. The powder filler material is fed by one feeding hose to the plasma nozzle (4 holes). The non melting electrodes are generally tungsten electrodes with oxide additions. The tungsten electrode diameter being 4 mm. The standard length of the tube package is 4 m. Longer tube packages are available on request.

Construction:	Machine torch
Max current:	280 A
Powder flow rate:	Max. 75 g/min (depending on powder density)
Description:	Water cooled machine torch for high duty applications

DURMAT® PT 400AUT

The plasma-powder-welding torch DURMAT® PT 400AUT is designed for semi-automatic or automatic welding with welding manipulators or robots. The powder filler material is fed by two feeding hoses to the plasma nozzle (6 holes). The separately feeding of matrix powder and carbides is possible by using two separate powder feeders. Compared to the PT 300 the deposition rate is much higher. The non melting electrodes are generally tungsten electrodes with oxide additions. The tungsten electrode diameter being 4 mm. The standard length of the tube package is 4 m. Longer tube packages are available on request.



Construction:	Machine torch
Max current:	300 A
Powder flow rate:	Max. 100 g/min (depending on powder density)
Description:	Water cooled machine torch for high duty applications

DURMAT® PT 200i - 80ID

The PTA torch DURMAT® PT 200i - 80ID is specially designed for ID deposition welding. The minimum diameter which can be coated is 80 mm. Based on a separate air cooling of the torch shaft the torch can be used in preheated bores up to 300 °C (572 °F).

Depending on application and torch construction, the torches can be positioned by automats or by robots. The standard shaft length is 850 mm. Other lengths are available on request. The torch is available with a 5 m tube package with single connectors or (optional) with robot fast connector and robot tube package, see product SK-ROB.

Construction:	Horizontal, 300 °C ambient temperature
Max current:	200 A
Powder flow rate:	Max. 50 g/min (depending on powder density)
Standard length:	850 mm (others on request)
Description:	Machine torch for inner coatings (diameter > 80 mm)

DURMAT® PT 150i - 65ID

The PTA torch DURMAT® PT 150i - 65ID is specially designed to use special anodes. Those anodes are allowed to hardface pipes with a minimum inner diameter > 65 mm. The standard tungsten electrode diameter being 4 mm.

Depending on application and torch construction, the torches can be positioned by automats or by robots. The standard shaft length is 850 mm. Other lengths are available on request. The torch is available with a 5 m tube package with single connectors or (optional) with robot fast connector and robot tube package, see data sheet SK-ROB.

Construction:	horizontal, 150 °C ambient temperature
Max current:	150 A
Powder flow rate:	Max. 40 g/min (depending on powder density)
Standard length:	600 mm (others on request)
Description:	Machine torch for inner coatings (diameter > 65 mm)

Rev. 2.0 (04.2018)

DURMAT® PT 200S AUT

The plasma-powder-welding torch DURMAT® PT 200S AUT is designed to use special anodes, which allow hard-facing in poorly accessible welding areas, e.g. glass moulds. The non melting electrodes are generally tungsten electrodes with oxide additions. The tungsten electrode diameter being 2.4 or 4 mm. Depending on application and torch construction, the torches can be positioned by automats (AUT torches) or by robots (ROB torches). The standard length of the tube package is 4 m. Longer tube packages are available on request.

Construction:	Machine torch
Max current:	200 A
Powder flow rate:	Max. 60 g/min (depending on powder density)
Description:	Water cooled torch

DURMAT® PT 400ROB

The plasma-powder-welding torch DURMAT® PT 400 ROB is specially designed for continuous PTA hard-facing with high deposition rate. Based on the integrated fast coupling system the torch must be dismantled or changed for maintenance fast and easily. Depending on application and torch construction, the torches can be positioned by automats (AUT torches) or by robots (robot torches).

The torch must be connected ONLY to special robot tube package which is not included.

Construction:	Robot / machine torch
Max current:	150 A
Powder flow rate:	5 - 20 g/min (depending on powder density)
Description:	Water cooled torch

PFU 4

The powder feeder PFU 4 is available with one or two powder feeding outlets. The maximum feeding rate is 200 g/min*. Two powder feeders PFU 4 can be driven in parallel (only by power sources with the optional second motor control card) for applications that require feeding of different powders in the weld pool, e.g. matrix and carbides.

Feeding rate step controlled via feeding wheel speed directly from PLC. The stand alone system is available on request.

Carrier gas:	Ar
Carrier gas flow rate:	0 - 6 l/min
Powder reservoir:	2.3 l
Dimensions (L x W x H):	310 x 170 x 470 mm
Powder feed rate*:	2 - 200 g/min
Container size:	12 kg max. (depending on density)
Gas pressure:	max. 1 bar
Weight:	7.5 kg

* Depending on feeding wheel configuration, torch, anode and powder density

PFU 35

The powder feeder PFU 35 is designed for continuous hard-facing process and is available with one or two powder feeding outlets. The maximum powder feeding rate is 200 g/min*). The maximum powder capacity is 35 kg. The powder container has an integrated sensor to monitor the minimum filling level (1 kg).

Carrier gas:	Ar
Carrier gas flow rate:	0 - 6 l/min
Powder reservoir:	35 kg max (depending on density)
Dimensions (L x W x H):	240 x 260 x 670 mm
Powder feed rate*:	2 - 200 g/min
Gas pressure:	max. 1 bar
Weight:	15 kg

* Depending on feeding wheel configuration, torch, anode and powder density

Quick coupling for PTA torches

The quick coupling system SK - ROB and the torch holder PTH 45 were developed for the PTA torches DURMAT® PT - series. It can be used for all automatic or semi-automatic welding systems.

Water cooling and welding gases (plasma gas, shielding gas) are lead to the welding head via the central coupling plug. The plug for the powder feed and the pilot current are outside of the central coupling. The whole PTA welding torch combined with the quick coupling system SK - ROB and the torch holder PTH 45 can be exchanged or removed from the machine for maintenance easily without disassembling the hose package.

Main current:	10 - 300 Ampere
Pilot current:	10 - 20 Ampere
Tube package:	10m

DURMAT® PT 400 ROB with SK-ROB

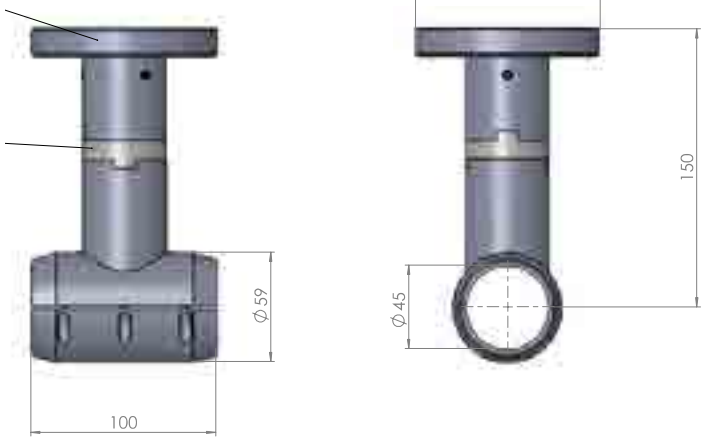
DURMAT® PT 400 ROB with SK-ROB and tube package

Torch holder **DURMAT® PTH 45**

The torch holder PTH 45 is available for all DURMAT® PTA torches. It can be connected to robot switch-off sockets or other manipulator equipment. Based on the integrated insulation short circuits between torch and manipulator can be avoided.

Drill pattern flange customer-specific

Insulation



Non-magnetic Hard-facing Materials

DURUM's commitment to investing in new technological advances, as they relate to material science and process application has resulted in several recent developments that have demonstrated superior performance in terms of reducing wear on critical downhole tools while improving consistency in harsh/aggressive drilling environments.

Primarily, non-magnetic drill collars are used to reduce the interference of the magnetic fields that may affect dedicated directional equipment. In respect, DURUM has focused their efforts towards developing new materials for the Hard-facing of non-magnetic drill collars and stabilizers with the specific intent of minimizing magnetic survey errors.

Our materials meet the magnetic (relative) permeability requirements of API specification 7 and have achieved results below the magnetic field gradient (hot spot) of 0.05 micro Tesla/100 mm.

Materials for non-magnetic Hard-facing include:

- PTA Powders
- Laser Powders and Wires
- Flux-Cored Wires

All wires and powders are available with or without Fused Tungsten Carbide (DURMAT® FTC), Spherical Tungsten Carbide (DURMAT® SFTC) and extra hard Special Carbides to effectively accommodate virtually any application.

Rev. 2.0 (04.2018)

DURMAT® 437 PTA

PTA powder for Non-Magnetic application

DURMAT® 437 PTA is a nickel based PTA metal powder containing Fused Tungsten Carbide (DURMAT® FTC) for Non-magnetic applications.

Application:
Plasma powder surfacing of Non-magnetic drilling tools.

Physical characteristics:

Hardness Matrix:	up to 30 HRC
Hardness:	FTC: 2,340 HV
Grain Size:	- 160 / + 63 µm (others on request)

Typical chemical composition of weld metal (Wt-%):

Ni	Cu	C	B	Si	Fe	FTC

Typical matrix chemistry:
Proprietary Non-Magnetic, crack resistance is good, if adequate preheat and interpass temperature are applied, together with slow cooling after welding is completed.

DURMAT® 438 PTA

PTA powder for Non-Magnetic application

DURMAT® 438 PTA is a nickel based PTA metal powder for Non-magnetic applications.

Application:
Plasma powder surfacing of special oil & gas tools.

Physical characteristics:

Hardness:	180 - 230 HB
Melting point:	985 °C
Density:	8.45 g/cm³
Grain Size:	- 160 / + 63 µm

Typical Chemical Composition of Weld Metal (Wt-%):

Ni	Cu	C	B	Si	Fe

Typical Matrix Chemistry:
Proprietary Non-Magnetic, crack resistance is good, if adequate preheat and interpass temperature are applied, together with slow cooling after welding is completed.

DURMAT® 625 PTA

PTA metal powder for corrosion resistant hard-facings

DURMAT® 625 PTA is high corrosion resistant e.g. in acids with chloride content or sea water. Good resistance against abrasion and friction. High ductility.

Application:
Buffer layers on downhole tools (drill collars, stabilizers etc.)

Hardness:
Hardness: 210 $HV_{0.1}$
Density: 8.1 g/cm³
Grain Size: - 160 / + 63 µm

Typical chemical composition of weld metal (Wt-%):

C	Cr	Mo	Nb	Fe	Ni
0.05	21	9.2	3.5	3	bal.

Typical matrix chemistry:
Proprietary Non-Magnetic, crack resistance is good, if adequate preheat and interpass temperature are applied, together with slow cooling after welding is completed.

DURMAT® 668 PTA

PTA metal powder for non-magnetic overlaying

DURMAT® 668 PTA is a crack free PTA powder especially designed for Non-Magnetic components.

Application:
Non-mag drill collars, stabilizers, build-up worn parts

Hardness:

Hardness:	work hardened up-to 500 HB
Melting point:	1,310 °C
Density:	8.0 g/cm³
Structure:	fully austenitic Mn/Cr type
Grain Size:	- 160 / + 63 µm (others on request)

Typical chemical composition of weld metal:
Fe-Ni-Mn-Cr-Fe alloyed fully austenitic Mn/Cr alloy with small primary special carbides for extended wear resistance.

Typical matrix chemistry:
Proprietary Non-Magnetic, crack resistance is good, if adequate preheat and interpass temperature are applied, together with slow cooling after welding is completed.

DURMAT® FD 677

Flux-Cored Wire acc. to DIN EN 14700

General characteristics:
DURMAT® FD 677 is a crack free hard-banding wire designed for Non-Mag components: fully austenitic Mn-Cr-type of Flux Cored Wire with especially designed carbides for improved wear resistance. The stainless and non-magnetic overlay can harden up to 500 HB. The deposits resist high shrinkage and impact stresses.

Application:
Non-magnetic base materials such as non-mag drill collars, stabilizers and other related components. Very good wear resistance due to the embedded special carbides.

Hardness:
40 HRC

Typical chemical composition of weld metal (Wt-%):

C	Si	Mn	Cr	Ni	Mo	V	Fe
< 2	< 2	< 25	< 25	< 10	< 5	< 20	bal.

Welding recommendation:

Dia. mm	Inch	Voltage	Amps
1.6	1/16	20 - 26	180 - 220
2.0	5/64	22 - 26	220 - 250
2.4	3/32	24 -27	260 - 300

General Information: DURUM is an ISO 9001 certified producer of wear resistant materials with more than 30 years experience in producing and applying wear resistant products for oilfield applications.

TÜV CERT
DIN EN ISO 9001:2008
Cert. Reg. No. 01 100 040463

DURMAT® FD 777

Flux-Cored Wire acc. to DIN EN 14700

General characteristics:
DURMAT® FD 777 is a Flux-Cored Wire containing approx. 50 % - 65 % Fused Tungsten Carbide in an austenitic NiCu-matrix, providing a wear resistant, Non-magnetic overlay.

Physical characteristics:
Hardness FTC: > 2,200 $HV_{0.1}$
Hardness Matrix: 400 - 540 $HV_{0.1}$

Typical chemical composition of weld metal (Wt-%):

FTC	Cu	B	NI	Si	C
50 - 65	< 35	< 5	bal.	< 5	< 1

Welding recommendation:

Dia. mm	Inch	Voltage	Amps
1.6	1/16	18 - 20	160 - 180

Typical matrix chemistry:
Proprietary Non-Magnetic, crack resistance is good, if adequate preheat and interpass temperature are applied, together with slow cooling after welding is completed.

DURMAT® FD 1744

Flux-Cored Wire acc. to DIN EN 14700 for Non-magnetic application

General Characteristics:
DURMAT® FD 1744 is a Flux-Cored Wire specifically designed for Non-magnetic applications. The alloy has good corrosion resistance, especially in sea water and caustic environments.

Physical characteristics:
Hardness: 30 HRC

Typical chemical composition of weld metal (Wt-%):

Mn	Cu	B	Ni	Si	C

Welding recommendation:

Dia. mm	Inch	Voltage	Amps
1.6	1/16	18 - 20	160 - 180

Rev. 2.0 (04.2018)

Drill Pipe Hard-banding

Please ask for our special cataloge for Drill-Pipe Hard-banding

DURMAT® Casing friendly Hard-facing Wires are specially developed to reduce casing wear and to extend life of tool-joints.

With the experience of more than 35 years in producing Hard-facing Wires for all kinds of industrial applications DURUM is offering a wide range of crack-free Hard-facing wires. Most wires are Open Arc (no extra shielding gas or flux required) and some wires can be applied and reapplied on itself.

DURUM understands the requirements of the down hole drilling industry and can provide you with unique types of wires made to your specifications.

A few of the primary factors include:

- The addition of elements such as Niobium, Molybdenum, Titanium, Cobalt, Titanium or Vanadium are beneficial by forming the respective carbides that reduce the coefficient of friction;
- The formation of microstructures that exhibit amazing stability during high temperature conditions resulting from friction;
- The use of alloying elements that improve the thermal conductivity to minimize typical coating failures (i.e., heat checking).

Our involvement in hard-banding started in 1976 when Tungsten Carbide was the most popular wear resistant material for overlaying tool joints and other parts.

At the 1991 SPE IADC Drilling Conference held in Amsterdam, 11-14 March 1991 DURUM presented a paper called: Evaluation of New Tool Joint Hard-facing Material for Extended Connection Life and Minimum Casing Wear.

In between 1999 to 2001 several casing friendly wires had been approved and tested by Maurer and successfully approved by major oil companies.

DURUM has been a front-runner in materials research and application. Several patents validate our on-going research and development program for Wear Protection Materials and applications.

Fearnley Procter NS-1 PRODUCT LEVEL 2

DURMAT® FD 665 got Fearnley Procter NS - 1™ Level 2 Process aproved.

DURMAT® FD 665

Please ask for our special cataloge for Drill-Pipe Hard-banding

Flux-Cored Wire acc. to DIN EN 14700

General characteristics:
DURMAT® FD 665 is a casing friendly NS-1 certified Flux-Cored Wire, especially designed for hard facing of Drill Pipes and Drill collars.

DURMAT® FD 665 is an Iron based Flux-cored wire which produces a finely dispersed Titanium Carbide alloy deposit for semi-automatic and fully automatic surfacing. The weld metal is tough and not sensitive to impact loads. Crack resistance is good, provided adequate preheat and interpass temperature are applied, together with slow cooling after welding is completed. Best suited for tool joints subjected to abrasion and impact loads.

Hardness:
56 - 61 HRC

Typical chemical composition of weld metal (Wt-%):

C	Mn	Si	Cr	Mo	Ti	Fe
< 5	< 3	< 3	< 10	< 5	< 10	bel.

Welding recommendations:

DIA. MM	INCH	VOLTAGE	AMPS
1.6	1/16	20 - 25	190 - 230
2.0	5/64	22 - 26	240 - 280
2.4	3/32	24 - 27	280 - 340

Coiling:
Coil „S“ = 15 KGs, coil „B“ = 25 KGs, pay off pack = 250 KGs

Fearnley Procter NS-1 LEVEL 2

General Information:
DURUM is an ISO 9001 certified producer of Flux-Cored Wires with more than 30 years experience in producing and applying wear resistant products for oilfield applications.

TÜV CERT
DIN EN ISO 9001:2008
Cert. Reg. No. 01 100 040463

Rev. 2.0 (04.2018)

DURMAT® AS 760

Please ask for our special cataloge for Drill-Pipe Hard-banding

Flux-Cored Wire acc. to DIN EN 14700

General characteristics:

DURMAT® AS 760 is an GAS shielded nickel based wire with a high content of special carbides and borides.

- Can be re-applied without stripping
- Exceptional drill-pipe protection
- Unsurpassed casing protection
- Low preheat application
- Easily welded and re-applied
- Tungsten-free
- Highest-level of Casing protection
- Visually No-Cracking
- Non Spalling
- Nickel-based for Higher Corrosion Resistance

Hardness:

40 - 45 HRC

Typical chemical composition of weld metal (Wt-%):

Ni	Si	B	Cr	Others
> 50	< 5	< 6	< 15	< 15

Welding recommendations:

DIA. MM	INCH	VOLTAGE	AMPS
1.6	1/16	19 - 21	180 - 220
2.0	5/64	20 - 22	220 - 250
2.4	3/32	22 - 24	260 - 300

Coiling:

Coil „S“ = 15 KGs
coil „B“ = 25 KGs
pay off pack = 250 KGs

General Information:

DURUM is an ISO 9001 certified producer of Flux-Cored Wires with more than 30 years experience in producing and applying wear resistant products for oilfield applications.

TÜV CERT
DIN EN ISO 9001:2008
Cert. Reg. No. 01 100 040463

DURMAT® – Cobalt Base Alloys

DURMAT® cobalt base hard alloys are mostly produced from the Co-Cr-W-C system, which was originally intended for cutting tools. Within these alloys, the metal matrix shows a Co-Cr-W-mixed crystal that may contain precipitated WC as well since the solubility of WC reduces with rising temperature. This way, metal matrices have micro-hardnesses of up to 450 $HV_{0.05}$. Cold hardening can even achieve structure strengths of up to 650 $HV_{0.05}$.

Cobalt base hard alloys tend to cold-harden due to their intrinsically low stacking fault energy that facilitates the planar and transverse sliding of offsets and thus gives the structure a high (creepage) strength. Such deformation mechanisms can permit these alloys to harden very quickly while at the same time ensuring good resistance against friction wear.

The carbide-containing cobalt base alloys all have a high chrome ratio that tends to form a passive layer on the surface, similar to that of stainless steel. This phenomenon gives these alloys a good corrosion resistance, in particular in oxidising environments. The molybdenum-containing DURMAT® cobalt base hard alloys (e.g. Durolit 21) have been developed specifically for further improving corrosion resistance in reducing and complex atmospheres.

Furthermore, precipitation hardening through intermetallic phases is of high importance for cobalt base hard alloys. With the corresponding contents of tungsten and molybdenum, intermetallic phases of the Co_3 (W, Mo) type may precipitate after solution annealing. Therefore, such metal matrices are in the best case suitable even for applications at up to 1,000 °C, since the strength loss due to over-aging is low.

A further contribution to solidification of cobalt is the allotropic phase transformation: Cobalt has a face-centred cubic lattice structure (fcc) at high temperatures (> 417 °C) and transforms to a hexagonal close-packed lattice structure (hcp) during cooling. However, this conversion is so slow that a metastable fcc-phase in the weld metal occurs. This fcc-phase at ist turn can be transformed into the hcp-structure by special processes. This phase transformation as well as the low stacking fault energy give cobalt base alloys unique wear properties, especially with regard to sliding abrasion and fretting.

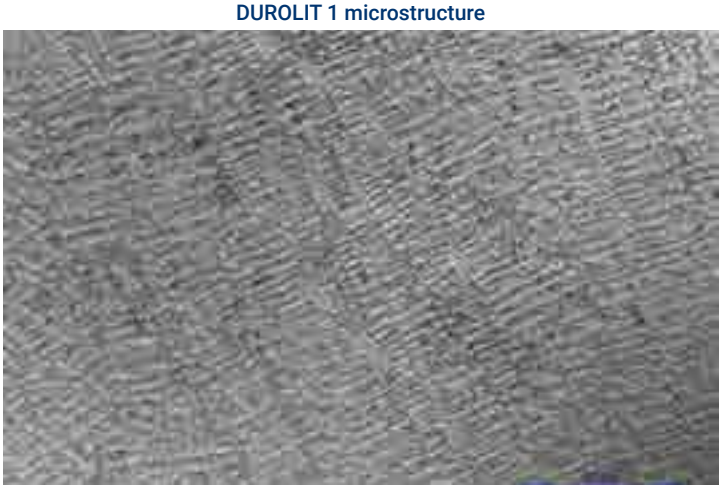
DURMAT® Cobalt base hard alloys may be used together with many base materials, such as carbon steels, un- and low-alloyed steels or stainless steels. Pre-heating is often necessary to ensure crack-free application. A buffer layer with DURMAT® FD 250K is recommended at multiple-layer welds.

Rev. 2.0 (04.2018)

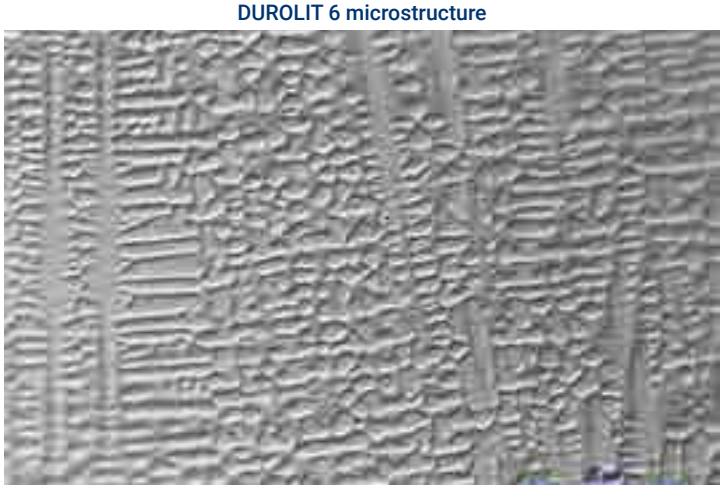
Co-based Flux-Cored Wires

DURMAT®	CLASSIFICATION TYPICAL APPLICATIONS TYPICAL CHEMICAL COMPOSITION* (Wt.-%) OF WELD METAL												HARDNESS	TYPICAL PROPERTIES
	C	Si	Mn	Cr	Ni	Mo	Co	Nb	V	W	Fe	+		
DUROLIT 1	DIN EN 14700: T Co3 / DIN 8555: MF 20-55-CGTZ / AWS 5.21 - ERC CoCrC Wear pads, rotary seal rings, pump sleeves; centre less grinder work rests, etc.												55 HRC 600 °C: 44 HRC 800 °C: 34 HRC	• Austenitic-ledeburitic structure. • Great resistance to corrosion, reducing acids, impact, extreme wear and temperature shocks . • Only machinable by grinding. • Tensile strength: 630 N/mm².
	2.4	0.7	0.4	29	-	-	bal.	-	-	12	< 4	-		
DUROLIT 6	DIN EN 14700: T Co2 / DIN 8555: MF 20-45-CTZ / AWS 5.21 - ERC CoCrA Steam and chemical valves, equipment handling hot steel such as tong bits, shear blades, pumps for high temperature liquids, etc.												40 - 43 HRC 300 °C: 35 HRC 600 °C: 29 HRC	• Austenitic-ledeburitic structure. • Great resistance to corrosion, reducing acids, impact, extreme wear and temperature shocks. • Machinable by hard faced tools. • Tensile strength: 900 N/mm².
	1.1	1	0.6	27	-	-	bal.	-	-	4.5	< 4	-		
DUROLIT 6 LC	DIN EN 14700: T Co2 / DIN 8555: MF 20-40-CTZ Abrasion, erosion, corrosion, cavitation at high temperatures, pumps, extrusion screws, bearing surfaces, chemical industry, hot shear blades, valves, etc.												36 - 39 HRC	• Austenitic structure bearing chrome and tungsten carbides. • Resistant to high corrosion and abrasion, high impact stress and extreme temperature shocks. • Machinable by hard metal tools.
	0.8	1	0.8	28	-	-	bal.	-	-	4.5	< 4	-		
DUROLIT 6 HC	DIN EN 14700: T Co2 / DIN 8555: MF 20-45-CTZ Steam and chemical valves, equipment handling hot steel such as tong bits, shear blades, pumps for high temperature liquids, etc.												43 - 46 HRC	• Austenitic structure bearing chrome and tungsten carbides. • Resistant to high corrosion and abrasion, high impact stress and extreme temperature shocks. • Machinable by hard metal tools.
	1.3	1	0.8	29	-	-	bal.	-	-	4.5	< 3	-		
DUROLIT 12	DIN EN 14700: T Co3 / DIN 8555: MF 20-50 CTZ / AWS 5.21 - ERC CoCrB Cutting edges of long knifes and other tools used in the wood, plastic, paper, carpet and chemical industry, etc.												45 - 48 HRC 300 °C: 37 HRC 600 °C: 32 HRC	• Austenitic-ledeburitic structure. • Improved wear resistance compared to DUROLIT 6, used for applications exposed to reduced mechanical shock. • Machinable by hard faced tools. • Tensile strength: 850 N/mm².
	1.4	0.8	0.6	29	-	-	bal.	-	-	8	< 3	-		
DUROLIT 21	DIN EN 14700: T Co1 / DIN 8555: MF 20-350-CKTZ / AWS 5.21 - ERC CoCrE Components which are exposed to high temperatures, corrosion and impact stress, such as valve seats, components in the chemical industry.												30 HRC After work hardening: 45 HRC	• Cobalt alloy with the highest corrosion and thermal resistance of all cobalt-base alloys • Machineable.
	0.25	0.8	0.8	27	2.5	5.5	bal.	-	-	-	< 4	-		
DUROLIT 25	DIN EN 14700: T Z Co1 / DIN 8555: MF 20-300-CKTZ Hot forging tools, turbo charger buckets, parts subject to high operating temperatures with all types of wear such as impact, pressure, corrosion, erosion.												250 - 280 HB	• Contains approximately 10.5 % nickel for matrix stability during elevated temperature service. • Resistant to hot corrosion, impact, wear, extreme temperature shocks and oxidation. • Machinable by hard faced tools.
	0.1	0.5	0.1	20	10	-	bal.	-	-	15	< 4	-		

DUROLIT 1 microstructure



DUROLIT 6 microstructure



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Quality Control:

In-House

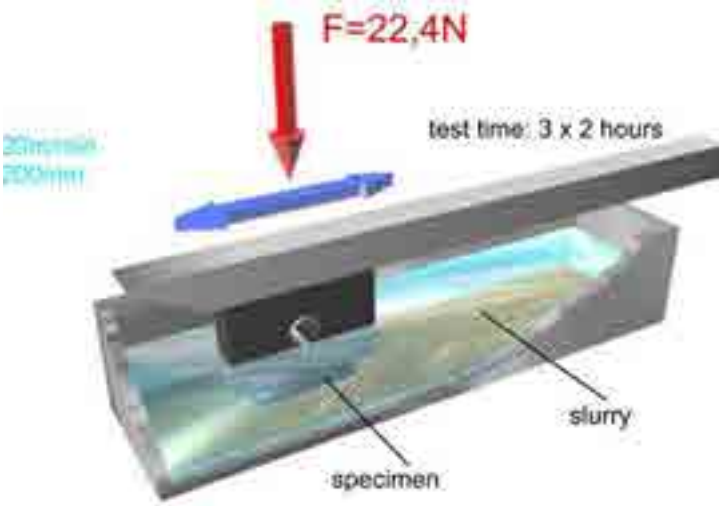
Wear Testing

ASTM G65 - 04

ASTM G75 - 07

Wear Testing:
ASTM G75 - 07 – Miller test

Schematic diagram:



Motor-driven rotor causes the oscillating movement of the specimen by an eccentric fitted connecting rod:

- The specimens are weighed before and after the test and the wear is reported in mm^3
- Comparable worlwide
- High amount of variations of solid-fluid-mixture

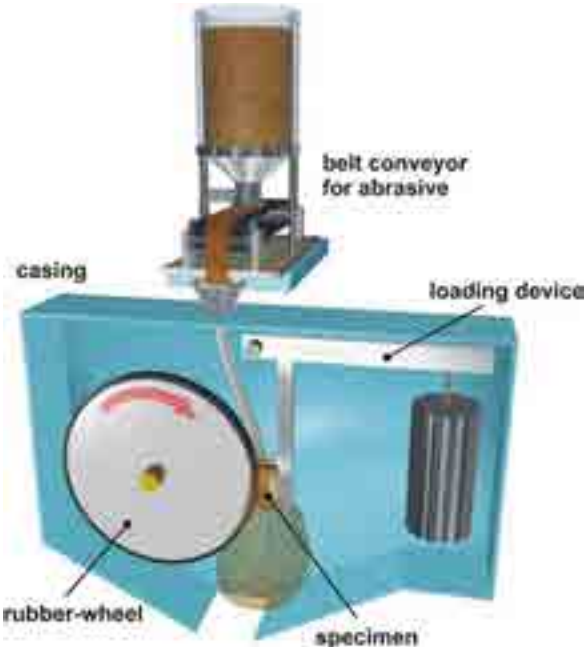
Two ways to run the test:

1) **Standardized slurry** ==> **abrasiv resistance of the material**

2) **Standardized specimen** ==> **abrasiveness of the slurry**

Wear Testing:
ASTM G65-07 – friction wheel test

Schematic diagram:



Modification	Contact force [N]	Wear distance [m]
A	130	4,309
B	130	1,436
C	130	71.8
D	45	4,309
E	130	718

Modification	Notes
A	Materials with medium and high hardness
B	Short Version of "A"
C	Thin coatings
D	Materials with low wear resistance
E	Short version of "A"

- The specimens are weighed before and after the test and the wear is reported in mm³
- Standardized test procedure offers a broad spectrum of materials to test

Example:
ASTM G65: 3 Body - Abrasiv Wear

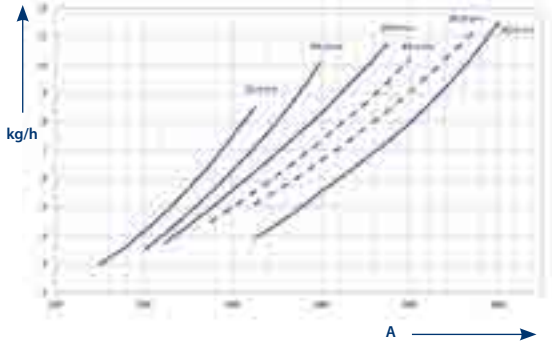
Abrasive:	quartz sand (F50/70)
Abrasive Particle Size:	200 - 300 µm
Abrasive flow:	310 - 350 g/min
Contact force:	130 N
Wear distance:	4,309 m
Rotational speed:	200 rpm
Diameter wheel:	ø 216 - 228 mm
Sample dimensions:	65 x 25 x 15 mm

Wear mark

Useful Informations

DIMENSIONS, WELDING CURRENT (TYPICAL VALUES)						
Process	ø [mm]	Welding current [A]	Arc Voltage [V]	Welding Speed [cm/min]	Stick out [mm]	Power type, Polarity
Open Arc	1.6 2.0 2.4 2.8 3.2	180 - 200 200 - 250 25 - 300 30 - 350 350 - 400	26 - 30 26 - 30 26 - 30 26 - 30 26 - 30	- - - - -	30 - 35 35 - 40 35 - 40 35 - 40 35 - 40	DC (electrode to + pole)
SAW	3.2 4.0	325 - 450 400 - 500	28 - 30 28 - 30	35 - 45 40 - 45	30 - 35 30 - 35	DC (electrode to + pole)

ABSCHMELZLEISTUNG (Richtwerte bei 100 % ED - stick out ca. 35 mm)



MESH-MICRON CONVERSION TABLE			
Micron	Mesh UK	Mesh USA (ASTM)	Mesh USA (TYLER)
8000	n/a	5/16 in	2.5
6700	1	0.265 in	3
5600	3	3.5	3.5
4750	3.5	n/a	4
4000	4	5	5
3350	5	6	6
2800	6	7	7
2360	7	8	8
2000	8	10	9
1700	10	12	10
1400	12	14	12
1180	14	16	14
1000	16	18	16
850	18	20	20
710	22	25	24
600	25	30	28
500	30	35	32
425	36	40	35
355	44	45	42
300	52	50	48
250	60	60	60
212	72	70	65
180	85	80	80
150	100	100	100
125	120	120	115
106	150	140	150
90	170	170	170
75	200	200	200
63	240	230	250
53	300	270	270
45	350	325	325
38	400	400	400
32	440	450	n/a
25	n/a	500	500
0	n/a	635	n/a

SHIELDING GAS (DIN EN 439)						
Symbol		Oxidising		Inert		Reductive
Group	Ident.-No.	CO_2	O_2	Ar	He	H_2
I	1	-	-	100	-	-
	2	-	-	-	100	-
	3	-	-	bal.	0,95	-
M1	1	0 - 5	-	bal.	-	0 - 5
	2	0 - 5	-	bal.	-	-
	3	-	0 - 3	bal.	-	-
	4	0 - 5	0 - 3	bal.	-	-
M2	1	5 - 25	-	bal.	-	-
	2	-	3 -10	bal.	-	-
	3	0 - 5	3 -10	bal.	-	-
	4	5 - 25	0 -8	bal.	-	-
M3	1	25 - 50	-	bal.	-	-
	2	-	10 - 15	bal.	-	-
	3	5 - 50	8 - 15	bal.	-	-
C	1	100	-	-	-	-
	2	bal.	0 - 30	-	-	-

WELDING RECOMENDATIONS				
Process	ø [mm]	Welding Current [A]	Arc voltage [V]	Deposition rate [kg/h]
Oxy-acetylene:				
- powder	-	-	-	0.2 - 1
- rod	3 - 8	-	-	< 2 kg
Standard Electrode	4	180	24	1.62
	5	250	25	2.01
High Performance Electrode	4	240	25	2.97
	5	350	26	4.30
Solid wire	1.2	150 - 300	23-30	2.2 / 5
	1.6	200 - 390	25 - 33	3 / 5.5
Cored wire	1.6	150 - 300	25 - 29	3 / 6.5
	2.4	240 - 400	26 - 31	4 / 7.5
	2.8	270 - 450	26 - 31	5 / 9.5
	3.2	300 - 500	26 - 31	6 / 11
PTA	-	50 - 400	20 - 50	0.5 - 20

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Useful Informations

SALES UNITS	Wire Coil	Wire Coil	Wood or Steel Coil	Drum	Drum
Net Weight (kg)	15	25	250/300	150	250
Ø outer (mm)	300	435	760	550	550
Ø hole (mm)	51.5	300	41	-	-
Width (mm)	103	105	290	-	-
Height (mm)	-	-	-	400	800
Standard	EN 759 - BS 300	EN 759 - B 435	EN 759 - S 760	-	-

ALLOY TYPES ACCORDING TO DIN EN 14700:2005

Alloy symbol[a]	Suit-ability	Alloy ratio of the pure weld metal deposit [weight-%]									
		C	Cr	Ni	Mn	Mo	W	V	Nb	other	Bal.
Fe1	p	≤ 0.4	≤ 3.5	-	0.5 - 3	≤ 1	≤ 1	≤ 1	-	-	Fe
Fe2	p	0.4 - 1.2	≤ 7	≤ 1	0.5 - 3	≤ 1	≤ 1	≤ 1	-	-	Fe
Fe3	s t	0.4 - 0.5	1 - 8	≤ 5	≤ 3	≤ 4.5	≤ 10	≤ 1.5	-	Co, Si	Fe
Fe4	s t (p)	0.4 - 1.2	2 - 6	≤ 4	≤ 3	≤ 10	≤ 19	≤ 4	-	Co, Ti	Fe
Fe5	c p s t w	≤ 0.5	≤ 0.1	17 - 22	≤ 1	3 - 5	-	-	-	Co, Al	Fe
Fe6	g p s	≤ 2.5	≤ 10	-	≤ 3	≤ 3	-	-	≤ 10	Ti	Fe
Fe7	c p t	≤ 0.2	4 - 30	≤ 6	≤ 3	≤ 2	-	≤ 1	≤ 1	Si	Fe
Fe8	g p t	0.2 - 2	5 - 18	-	0.3 - 3	≤ 4.5	≤ 2	≤ 2	≤ 10	Si, Ti	Fe
Fe9	k (n) p	0.3 - 1.2	≤ 19	≤ 3	11 - 18	≤ 2	-	≤ 1	-	Ti	Fe
Fe10	c k (n) p z	≤ 0.25	17 - 22	7 - 11	3 - 8	≤ 1.5	-	-	≤ 1.5	Si	Fe
Fe11	c n z	≤ 0.3	18 - 31	8 - 20	≤ 3	≤ 4	-	-	≤ 1.5	Cu	Fe
Fe12	c (n) z	≤ 0.08	17 - 26	9 - 26	0.5 - 3	≤ 4	-	-	≤ 1.5	-	Fe
Fe13	g	≤ 1.5	≤ 6.5	≤ 4	0.5 - 3	≤ 4	-	-	-	B, Ti	Fe
Fe14	g (c)	1.5 - 4.5	25 - 40	≤ 4	0.5 - 3	≤ 4	-	-	-	-	Fe
Fe15	g	4.5 - 5.5	20 - 40	≤ 4	0.5 - 3	≤ 2	-	-	≤ 10	B	Fe
Fe16	g z	4.5 - 7.5	10 - 40	-	≤ 3	≤ 9	≤ 8	≤ 10	≤ 10	B, Co	Fe
Fe20	c g t z	hard materials[b]	-	-	-	-	-	-	-	-	Fe
Ni1	c p t	≤ 1	15 - 30	bal.	0.3 - 1	≤ 6	≤ 2	≤ 1	-	Si, Fe, B	Ni
Ni2	c k p t z	≤ 0.1	15 - 30	bal.	≤ 1.5	≤ 28	≤ 8	≤ 1	≤ 4	Co, Si, Ti	Ni
Ni3	c p t	≤ 0.1	1 - 15	bal.	0.3 - 1	≤ 6	≤ 2	≤ 1	-	Si, Fe, B	Ni
Ni4	c k p t z	≤ 0.1	1 - 15	bal.	≤ 1.5	≤ 28	≤ 8	≤ 1	≤ 4	Co, Si, Ti	Ni
Ni20	c g t z	hard materials[b]	-	-	-	-	-	-	-	-	Ni
Co1	c k t z	≤ 0.6	20 - 35	≤ 10	0.1 - 2	≤ 10	≤ 15	-	≤ 1	Fe	Co
Co2	t z (c s)	0.6 - 3	20 - 35	≤ 4	0.1 - 2	-	4 - 10	-	-	Fe	Co
Co3	t z (c s)	1 - 3	20 - 35	≤ 4	≤ 2	≤1	6 - 14	-	-	Fe	Co
Cu1	c (n)	-	-	≤ 6	≤ 15	-	-	-	-	Al, Fe, Sn	Cu
Al1	c n	-	-	10 - 35	≤ 0.5	-	-	-	-	Cu, Si	Al
Cr	g n	1 - 5	bal.	-	≤ 1	-	-	15 - 30	-	Fe, B, Si, Zr	Cr

c: stainless
g: abrasion resistant
k: work hardenable

n: non-magnetizable
p: impact-resistant
s: edge retention

t: heat resistant
z: scale resistant
w: precipitation hardened

() may not apply to all alloys of this type

[a] Alloys which are not included in this table are analogies signified, but the letter Z shall be put in front
[b] Tungsten fused carbide or tungsten carbide broken or spherical

HÄRTE		
HV	HB	HRC
200	200	12.6
205	205	13.4
210	210	14.2
215	215	15.0
220	220	16.0
225	225	17.0
230	230	18.0
235	235	19.0
240	240	20.0
245	245	21.0
250	250	22.0
255	255	22.8
260	260	23.6
265	265	24.4
270	270	25.2
275	275	26.0
280	280	26.8
285	285	27.6
290	290	28.3
300	300	29.7
305	305	30.4
310	310	31.1
315	315	31.8
320	320	32.4
325	324	33.0
330	328	33.6
335	332	34.2
340	336	34.8
345	340	35.4
350	345	36.0
355	349	36.5
360	353	37.0
365	357	37.5
370	360	38.0
375	365	38.5
380	369	39.0
385	373	39.5
390	377	40.0
395	381	40.5
400	385	40.9
405	389	41.3
410	394	41.7
415	398	42.1
420	402	42.5
425	406	42.9
430	410	43.3
440	418	44.1
455	430	45.3

HÄRTE		
HV	HB	HRC
460	434	45.7
465	438	46.0
470	442	46.4
475	447	46.8
480	452	47.2
485	457	47.6
490	462	47.9
500	469	48.5
510	477	49.1
520	485	49.7
530	493	50.3
540	501	50.9
550	509	51.5
560	517	52.1
570	525	52.7
580	533	53.3
590	540	53.9
600	546	54.5
610	555	55.0
620	563	55.5
630	571	56.0
640	579	56.5
650	588	57.0
660	596	57.5
670	-	58.0
680	-	58.5
690	-	59.0
700	-	59.5
710	-	60.0
720	-	60.5
730	-	61.0
740	-	61.4
750	-	61.8
760	-	62.2
770	-	62.6
780	-	63.0
790	-	63.4
800	-	63.8
810	-	64.2
820	-	64.6
830	-	65.0
840	-	65.4
850	-	65.7
860	-	66.0
870	-	66.4
880	-	66.7
890	-	67.0
900	-	67.3

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